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REPAIR SYSTEM FOR DAMAGED COATINGS ON NAVY ANTENNA TOWERS - PAR--ETC(U)
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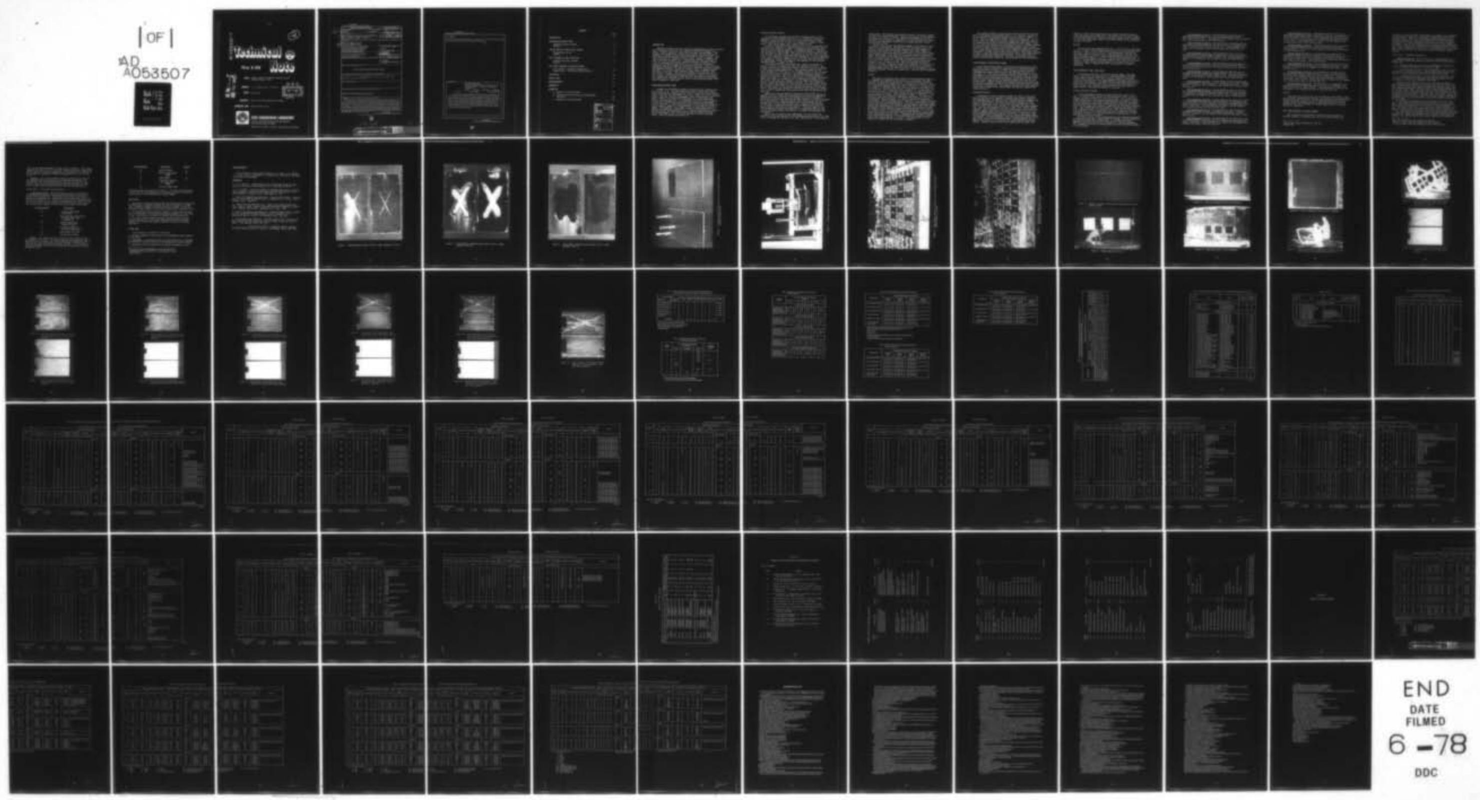

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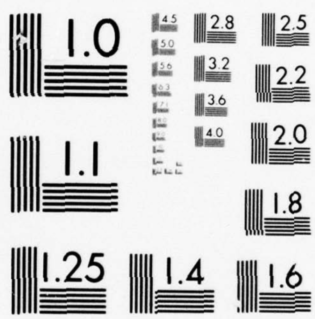

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A series of epoxy coating systems (some solvent-based and some water-emulsion) and an alkyd coating system were exposed on steel panels to a tropical environment for use in repair of damaged coatings on antenna towers. Laboratory bonding tests were conducted before and after exposure. Three candidate coating repair systems were applied on a tank exterior at San Nicolas Island, and a larger experiment using two surface preparations and 16 coating systems on an antenna positioner was initiated at the Pacific Missile Range, Point Mugu, (continued)

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CONTENTS

INTRODUCTION

Many Navy antenna towers are located in geographically remote locations where maintenance facilities are limited and severe environment (e.g., marine, tropical exposure) causes rapid localized coating damage. The heights and configurations of these towers permit only steeplejacks or repairmen utilizing an aerial-serving platform to reach all areas. Even then, some areas are frequently hard to reach. Repair of damaged coatings by conventional means (e.g., sandblasting and spray painting) is very costly and, in some cases, impossible because of physical limitations or environmental regulations (e.g., dry abrasive blasting is frequently restricted because of particulate emission). Thus, the Civil Engineering Laboratory (CEL) was directed by the Naval Facilities Engineering Command to develop a system for in-place repair of damaged exterior coatings. The work has been conducted along several different lines with various coatings. Each will be discussed in separate sections of this report. A variety of proprietary materials, specification paints, and a formulation developed at CEL have been investigated to determine the capability of different generic types to give good performance under severe atmospheric conditions.

WATER-EMULSION EPOXY STUDY

A number of water-emulsion epoxy coatings have been formulated for use on steel (1,2). The water emulsions usually contain some organic coupling solvent but readily meet all local air pollution control regulations. They have the advantages of low odor, safety (no fire or explosion hazard), and easy clean-up of equipment, lines, and personnel with water. They are also reported to bond well to oil and alkyd paints without softening them; thus, an intermediate tie coat is not required. In this way an alkyd-coated structure with localized coating damage could be repaired – or the entire structure could be topcoated directly – with an epoxy to improve its weatherability or resistance to abrasion damage. The polyamide curing agent in most of these formulations is reported as inhibiting corrosion (2). A limited investigation of water-emulsion epoxies disclosed many potential uses throughout the Naval shore establishment, such as exterior coatings for metal buildings, towers, tanks and support structures (3).

Weathered Systems Program

An experimental program was devised to determine both (1) the usefulness of water-emulsion epoxies in the touchup and topcoating of damaged or weathered alkyd paints and (2) the performance of these coatings applied directly on steel, as compared to a regular solvent epoxy, a low solvent epoxy, and a regular alkyd system.

A number of weathered alkyd panels (6 x 12 in.) were available from a previous 6-yr exposure to a marine atmosphere at Port Hueneme, Calif. They were of two separate systems: (1) Weathered System I: TT-E-489 over TT-E-485 over MIL-P-15328; and (2) Weathered System II: MIL-P-15130 over TT-P-645 over MIL-P-15328. Five panels of silicone alkyd TT-E-490 over TT-P-645 over MIL-P-15328 (Weathered System III) were also available after a 6-yr atmospheric exposure at Port Hueneme for a limited experiment to determine if silicone alkyds present any unique topcoating problem. The experimental design, developed to take advantage of the available weathered panels, is shown in Table 1.

The abrasive-blasted steel panels were coated as described in Table 2 to obtain a minimum total dry film thickness of 9 mils. All exposed topcoats were gray except System 3, which was white, and System 4, which had aluminum pigmentation. Each weathered panel had had a paint thickness of 5 mils and a 5-in. X-shaped scribe cut into its front surface before the 6-yr exposure. The Weathered System II panels had much more blistering in the scribe than did the Weathered System I panels (see Figure 1). When the scribed areas of the Weathered System II panels were power wire-brushed prior to repainting (as might occur in the field), wide pits were exposed in the blistered areas (Figure 2). System I panels had mostly filiform corrosion. The wire-brushed panels were all spot-primed (Figure 3) with TT-P-645 before the prime coat and the topcoat of each of the coatings systems were applied to fronts and backs. Individual coat thickness on weathered paint panels were identical to those on sandblasted steel panels since they were applied at the same time.

Analyses of the experimental coatings were made by CEL and are in Appendix A; their sources and identifications are listed in Appendix B. Analyses were made according to the methods outlined in Reference 4. Specification paints were certified by their suppliers to conform completely to specification. Hand brushing was used to spot-prime the wire-brushed areas on the weathered panels and to apply Coating System 4. All the other coatings were applied with an automatically controlled spray system as instructed by each supplier. The panel edges of each coating system were specially dipped into a trough containing the topcoat to eliminate possible edge effects. No application problems were encountered.

After 2 wk of curing at room temperature, a 10 in.-long X was scribed into the coating system of the sandblasted panels and a 2-in. long X was cut through the coating in the lower right portion of the weathered

paint panels. The scribing was designed to permit initiation of undercutting in the weathered systems. During this cutting, Coating System 2 was found to be very brittle and completely disbonded from the sandblasted panels and almost as completely from the weathered paint panels. The seven coating System 2 panels were not exposed because of their failure when scribed.

After 3 wk of curing, the bonding strength of each system to each substrate was determined. One-quarter of the unscribed side of each panel was lightly hand-sanded with aluminum oxide 108J sandpaper to provide a good surface for bonding of three steel probes (Figure 4). The surfaces of the probe ends were sandblasted to a white metal finish before being bonded to the panels with an epoxy adhesive (Aerobond No. 2210). The circular probe ends were exactly 1 sq cm in surface area. After the adhesive had cured overnight, the probes were pulled in tension at a rate of 0.5 cm/min in a table Instron Model TM testing machine (Figure 5) until failure occurred. Both the magnitude and type of failure were noted. Breaking strengths were recorded to the nearest 0.5 kg/sq cm. The failed areas were then spot-coated with the topcoat of Coating System 4 before the panels were sent to the CEL exposure site at Kwajalein, Marshall Islands, for exposure to a severe tropical atmosphere (Figure 6).

Results

The panels at Kwajalein were rated for field performance every 1/2 yr. Ratings were assigned by CEL personnel in accordance with ASTM standards as described in Reference 5. A numerical rating system was used for recording the degree of protection given by a coating: a rating of 10 indicated complete protection; and a rating of 0, no protection. For example, if the metal substrate had lost protection over 10% to 20% of its surface, the coating was given a rating of 8. In this report, a protection rating of 7 indicates coating failure, and that maintenance or recoating is necessary. These ratings are given in Appendix C. The general protection ratings are summarized in Table 3. It can be seen from this table that protection and general performance were better on the Weathered Coating Systems I, II, and III than on the sandblasted steel panels. This is probably due in large part to the greater thickness of the weathered coating system panels. Of the two water-emulsion epoxy systems that underwent field exposure, Coating System 1 performed notably better than Coating System 3 on the sandblasted steel panels, but their performances on the weathered coating system panels were quite similar. As a matter of fact, the performance of Coating Systems 1, 3, 4, 5, and 6 were quite similar on the coated panels; none showed any significantly better performance than any other. Coating System 4 performed slightly better than Coating System 6 on the sandblasted steel panels and much better than Coating Systems 1, 3, and 5. The panels after 3 yr of exposure are shown, but not identified, in Figure 7.

The bonding strength of each coating system (on both the front and back of each panel) was determined after 3 yr of exposure. Results of the initial and later bonding strength tests are given in Tables 4, 5, and 6. These are summarized in Table 7 for easier comparison. It can be seen from this table that bonding strengths were generally higher on the weathered paint panels than on the sandblasted steel panels. Also, on two of the four Weathered Coating System III panels, bonding strengths were significantly less than on corresponding System I and II panels. Overall, the epoxy coatings tended to lose bonding strength after exposure and a slight tendency for the front sides (which received direct solar radiation) to be more affected than the back sides. The bonding strengths of panels coated with alkyd Coating System 6, on the other hand, were greatly increased upon weathering. No direct relationship could be found between bonding strength of coating systems and field performance.

COATING REPAIR AT SAN NICOLAS ISLAND

Water tank coating failures at the Off-lying Landing Field (OLF), San Nicolas Island, presented an opportunity for a field experiment in comparing methods for repair of failed coatings; different surface treatments and primers underlying the same high quality topcoat were used (Table 8). The previous coating system (Coating System 1) on the experimental tank had been applied over a steel surface that was given a very deep surface profile when sandblasted, resulting in minimal thicknesses of coats that allowed only marginal amounts of cover over the profile peaks. Pinpoint rusting had started even before the final coat was applied, presumably because of the frequent fogs and adverse weather at the time of application. This pinpoint rusting led to the condition illustrated in Figure 8 that existed when the tank was inspected for coating failure.

Program Description

Performances of three candidate systems for repair of the water tank coating were to be compared; a superior epoxy topcoat (based on previous experience) was applied after different surface treatments and over different primers. The test area selected had heavy, uniform pinpoint rusting; the three 1-sq-yd plots were scrubbed with a wire brush to remove much of the rusting, its streaking, and other contamination. The area was allowed to dry for at least 1/2 hr before further treatment. Plot I (System 7) was first treated with a rust-converting primer, scrubbed with a brush, and allowed to stand for 2 hr; it was then thoroughly washed with water and air-dried. In addition to this surface preparation, Coating System 7 had an amine-cured epoxy primer coat applied. On Coating System 9, the same primer was used but without application of the rust-converting primer. Coating System 8 had an epoxy primer applied. All three used the same polyamide-cured epoxy topcoat. Figure 9 shows the plots after application of primer, and

Figure 10, after topcoat application; the primer and topcoat applications were made on successive days. The products used in each of these three coating systems are identified and their sources given in Appendix B. Each coat added about 3 mils of dry film thickness to the previously existing 7-1/2 mils.

Results

The test plots were examined after 1/2, 1, and 1-1/2 yr. After 1/2 and 1 yr the only coating deterioration noted was a heavy chalking (ASTM rating 2). After 1-1/2 yr, Plot III (Coating System 9) had only one very small pinpoint rust spot; Plot I (Coating System 7) had two very small rust spots, and Plot II (Coating System 8) had some topcoat cracking and peeling (Figures 11 and 12). All had some yellowing of the topcoat. Coating System 9 performed slightly better than Coating System 7 (identical systems except Coating System 7 was treated with a rust converter). Thus, it appears that this rust converter treatment is unnecessary.

FIELD EXPOSURE AT PMR, POINT MUGU

An antenna positioner at the Pacific Missile Range, Point Mugu, Calif., was used as the substrate for a field experiment on antenna coating repair systems. This steel structure (Figure 13) had been coated 15 mo earlier with a red-lead pigmented alkyd paint applied at a 2-mil dry film thickness. The painted surface was chalky and dirty but, except for a few localized rust spots, was providing good protection from corrosion. The location of the positioner on a spit between a lagoon and the ocean provided exposure to sea spray.

Antenna Positioner Program

In the experimental design, 32 square areas (16 x 16 in.) were used: 16 located on the top side of the positioner's base, 12 on the bottom of the base (Figure 14), and 4 on the arms. All 32 areas were cleaned preparatory to coating by scrubbing with a wire brush. Sixteen of the cleaned areas were treated chemically with the metal conditioner and rust converter as described in the previous section of this report, which had been shown (6) to provide a good base for painting wire-brushed steel. The brushed chemical was allowed to remain on the surface for 2 hr, rinsed with water, and allowed to dry. The other 16 areas were only wiped free of dirt or dust particles with a cloth after cleaning with the wire brush. The well-mixed paints were applied with a 1-in. wide brush to the test sections.

The materials used in the coating systems were promising experimental or proprietary coatings; Coating Systems 10 through 41 listed in Table 8 describe the primers and topcoats used. All topcoats were white. Appendix B gives the sources for the materials. Identifying numbers were assigned arbitrarily to these systems, which are described randomly in the following.

Coating Systems 10 and 13. Coating System 10 used one coat of amine-cured epoxy primer and a topcoat of polyamide-cured epoxy MIL-P-24441 (Formula 152). Coating System 13 is similar, but the chemical rust converter was used to treat the test area.

Coating Systems 16 and 19. Coating System 16, consisting of the same primer as Coating System 10 but with a topcoat of polyamide-cured epoxy, performed best in the San Nicolas test. Coating System 19 is similar, but the chemical rust converter was used to treat the test area.

Coating Systems 11 and 14. Coating System 11 used a coat of a modified polyester solution (28%) in mineral spirits with a topcoat of polyamide-cured epoxy MIL-P-24441 (Formula 152). Coating System 14 is similar, but the chemical rust converter was used to treat the test area.

Coating Systems 17 and 20. Coating System 17 used the same first coat as Coating System 11 and a topcoat of a polyamide-cured epoxy. Coating System 20 is similar but the chemical rust converter was used to treat the test area.

Coating Systems 12 and 15. Coating System 12 used one coat of polyamide-cured epoxy primer MIL-P-24441 (Formula 150) and a topcoat of polyamide-cured epoxy MIL-P-24441 (Formula 152). Coating System 15 is similar, but the chemical rust converter was used to treat the test area.

Coating Systems 18 and 21. Coating System 18 used the same primer as Coating System 12 with a topcoat of a polyamide-cured epoxy. Coating System 21 is similar, but the chemical rust converter was used to treat the test area.

Coating Systems 22 and 25. Coating System 22 used one coat of a CEL experimental underwater-applicable epoxy coating (7) and a topcoat of polyamide-cured epoxy MIL-P-24441 (Formula 152). Coating System 25 is similar but the chemical rust converter was used to treat the test area.

Coating Systems 23 and 26. Coating System 23 was identical to that of Coating System 22 except that 4% of an organotin wetting agent (the reaction product of bis tri-n-butyltin oxide with a vegetable acid) was added to the primer. Coating System 26 is similar, but the chemical rust converter was used to treat the test area.

Coating Systems 28 and 31. Coating System 28 used the primer of Coating System 22 and a topcoat of polyamide-cured epoxy. Coating System 31 is similar, but the chemical rust converter was used to treat the test area.

Coating Systems 29 and 32. Coating System 29 was identical to that of Coating System 28 except that 4% of the organotin wetting agent was added to the primer. Coating System 32 is similar but the chemical rust converter was used to treat the test area.

Coating Systems 24 and 27. Coating System 24 used a coat of an experimental ultraviolet-cured coating with a topcoat of polyamide-cured epoxy MIL-P-24441 (Formula 152). This system gave the best protection in the second series of accelerated salt spray testing, described later in this report. Coating System 27 is similar, but the chemical rust converter was used to treat the test area.

Coating Systems 30 and 33. Coating System 30 used the ultraviolet-cured coating of System 24 and a topcoat of polyamide-cured epoxy. Coating System 33 is similar, but the chemical rust converter was used to treat the test area.

Coating Systems 34 and 40. Coating System 34 consisted of an experimental primer with very fine particles of zinc/zinc-oxide alloy in a medium oil alkyd carrier with a topcoat of polyamide-cured epoxy MIL-P-24441 (Formula 152). Coating System 40 is similar but the chemical rust converter was used to treat the test area.

Coating Systems 36 and 41. Coating System 36 used the same primer as Coating System 34 with a topcoat of a polyamide-cured epoxy. Coating System 41 is similar but the chemical rust converter was used to treat the test area.

Coating Systems 35 and 38. Coating System 35 consists of quick-drying coatings that have found good use on towers at Vandenberg Air Force Base where frequent fogs limit paint curing times. It consisted of one coat of a chlorinated rubber zinc-rich primer and a high build chlorinated rubber topcoat. Coating System 38 is similar but the chemical rust converter was used to treat the test area.

Coating Systems 37 and 39. Coating System 37, recommended by the coating specialist at PMR, consisted of one coat of an inorganic zinc primer and an acrylic enamel topcoat. Coating System 39 is similar but the chemical rust converter was used to treat the test area.

Results

Inspection and rating of the test coatings were done monthly, using the previously discussed rating system. The ratings for the third month of exposure are shown in Table 9. All systems showed some discoloration. Coating System 22 exhibited spotting. Wrinkling occurred on Coating Systems 35, 36, and 38 through 41. Monthly inspections will continue during the coming year.

SALT SPRAY EXPOSURE OF COATING SYSTEMS

The salt spray test* provides a relatively quick procedure for scanning coatings to determine their ability to protect steel from

*Federal Test Method Standard No. 141A (6), Method 6061.

corrosion. In this procedure coated panels are exposed in an atmosphere of 5% or 20% salt spray and a temperature of approximately 95F in an enclosed chamber. This type of accelerated exposure produces results that make it possible to anticipate differences in field performance between inferior coating systems and those that give good or superior performance. Some of the systems exposed in the salt spray chamber were the same as those placed on exposure on the antenna positioner at Point Mugu. Thus, a comparison can be made of the performance of these systems. This 5% salt spray test was used on two series of different coating systems.

First Series - Different Preparations

Program Description. The first series of coatings tested were single coats of three experimental coatings with two different surface preparations.

1. Coating Systems 42 and 43 used an experimental coating that cures very rapidly when exposed to ultraviolet light.

2. Coating Systems 44 and 45 used CEL underwater epoxy (7) which wets surfaces very well because it contains blown fish oil and can be applied at a good thickness because of its high solids content.

3. Coating Systems 46 and 47 used the same CEL underwater epoxy with 4% of an organotin wetting agent (the reaction product of bis tri-n-butyltin oxide with a vegetable acid) added.

Twenty-four steel panels (12 x 6 x 1/8 in.) were corroded to a near-uniform surface condition in a 5% salt spray cabinet. These were then cleaned by manual wire-brushing, washing in distilled water, rinsing in methyl ethyl ketone, and air drying. Half (Coating Systems 42, 44, 46) were then coated. The other half (Coating Systems 43, 45, 47) were given a surface treatment before coating. This treatment consisted of brushing on the same metal conditioner and rust converter used in the experiments reported earlier, allowing to remain overnight, removing by scrubbing twice with distilled water, rinsing with methyl ethyl ketone, and air drying.

All coatings were applied to the test panels with a 1-in. wide brush. The ultraviolet-cured coating was allowed to stand for 15 min after application and then cured for 10 min to a hard, transparent, smooth surface* by exposing it to an ultraviolet light held about 1-ft away. The product has a very short shelf life. Half of each set of surface treated and untreated panels were scribed to bare metal with an X.

The coated panels were placed in a 5% salt spray cabinet and rated periodically. Figures 15 through 26 show the panels before and after exposure. The rating system was the same as that used in Reference 5

*When other batches of this product were used on other occasions, lumps were present in the wet paint so that a bumpy finish was obtained on the cured coating.

that utilizes ASTM photographic standards where available. The ratings ranged from a high of 10 to a low of 0. General protection ratings were the percentage of protected (undamaged) area divided by 10. Results of the testing are presented in Table 10 and Figures 16, 18, 20, 22, 24, and 26.

Results. The two CEL underwater epoxies performed very well and provided good general protection for all 180 days of testing. The ultraviolet-cured coating provided good general protection for only about 86 days. Overall, the panels that received treatment with the surface conditioner performed no better than the ones that did not.

Second Series – Ultraviolet-Cured Coating

Program Description. The second series was run to determine if topcoating the ultraviolet-cured coating would improve its ability to protect steel from rusting. Twenty-four 6 x 2-1/2 x 1/8-in. steel panels were sandblasted to a white metal finish (Steel Structures Painting Council Surface No. 5). Groups of four panels were coated with one coat of ultraviolet-curing coating as described for the first series of this section and a topcoat of one of the five coatings listed below:

Coating Systems	Topcoating
48	Silicone Alkyd Enamel MIL-E-46141
49	Epoxy Polyamide MIL-P-24441 (Formula 152) (same as System 24)
50	Medium Length Alkyd Enamel TT-E-485
51	Proprietary Phenolic Silicone Alkyd Enamel
52	Alkyd Enamel TT-E-489
53	Control (No topcoat)

Results. Two panels from each set of four were scribed to bare metal with a 2-in. long X. Salt spray exposure and ratings were made as described for the first series. The control panels failed after 74 days, but the other panels were rated for 155 days. At this time the ratings from high to low with the average general protection rating in parenthesis were:

Coating Systems	Topcoating	Rating
49	Epoxy Polyamide	9-
50	Medium Length Alkyd Enamel	8+
52	Alkyd Enamel	8-
51	Proprietary Phenolic Silicone Alkyd Enamel	7+
48	Silicone Alkyd Enamel	7

Detailed ratings are presented in Table 11. It can be seen from these ratings that the topcoating greatly increased the level of protection from corrosion in the laboratory salt spray chamber.

CONCLUSIONS

1. Coating steel panels with epoxy emulsion paint provides satisfactory patching repair of damaged coatings for tropical exposure. A slight loss of bonding strength of the epoxy emulsion coatings to steel was experienced when exposed to direct solar radiation for a period of time.

2. An ultraviolet radiation-curing coating is a fast-curing coating, but, as demonstrated in accelerated laboratory exposure in a salt spray cabinet, topcoating is necessary for maximum long-term protection.

3. The epoxy underwater paint developed by CEL provided excellent coating protection for steel panels when exposed in the salt spray cabinet but the high solid content presented a problem in brushing application.

FUTURE PLANS

The following are planned for the future:

1. Periodic examination and rating of the experimental paints exposed at Point Mugu.

2. Development, in cooperation with a private contractor, of coatings* plus methods of surface preparation and application of repair systems.

3. Laboratory and field evaluation of coatings developed in item 2.

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*Containing organo pyrophosphate titanate and other components that would result in easy application and rapid drying.

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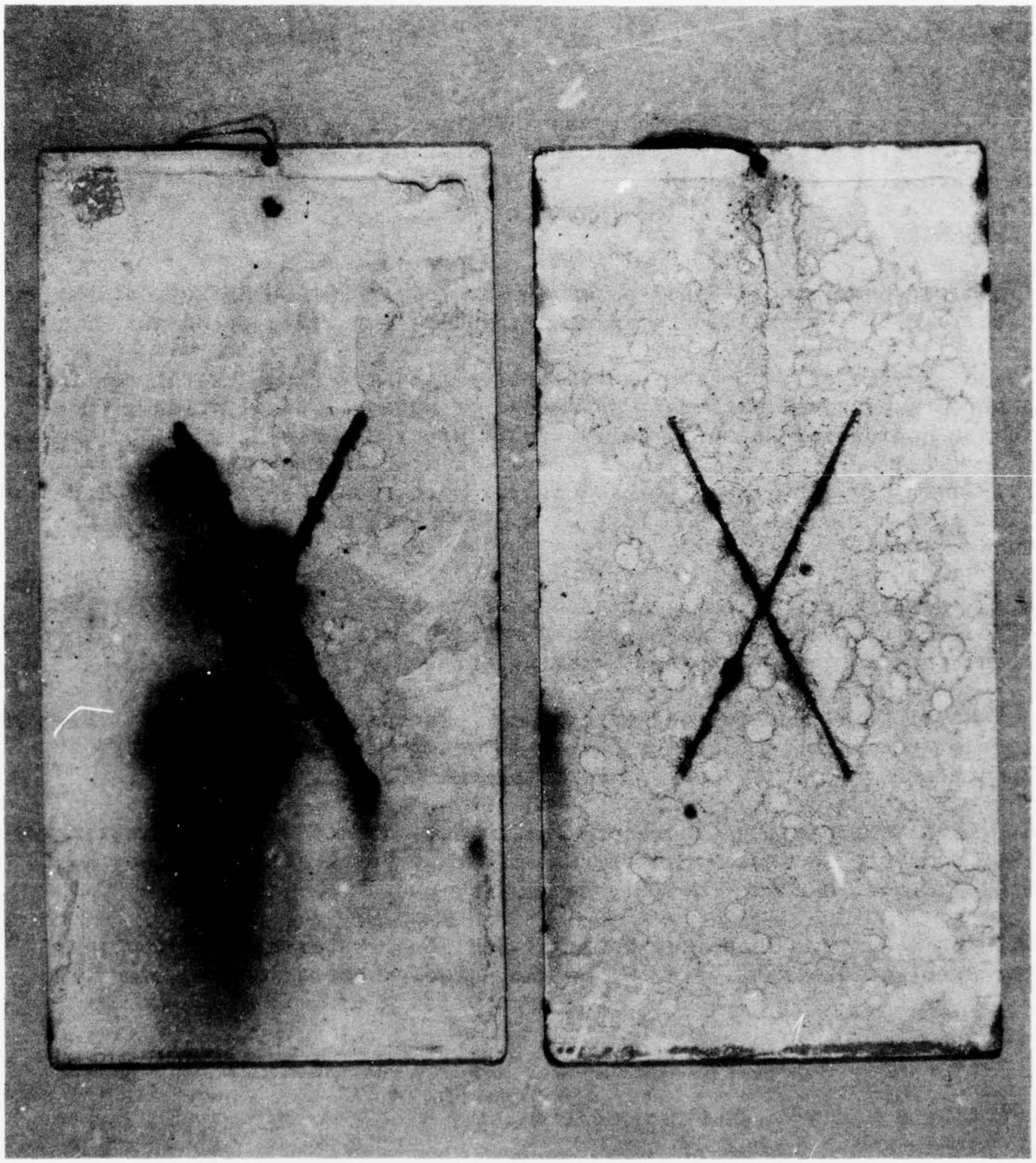

Figure 1. Weathered paint panels (left to right, Systems II and I).

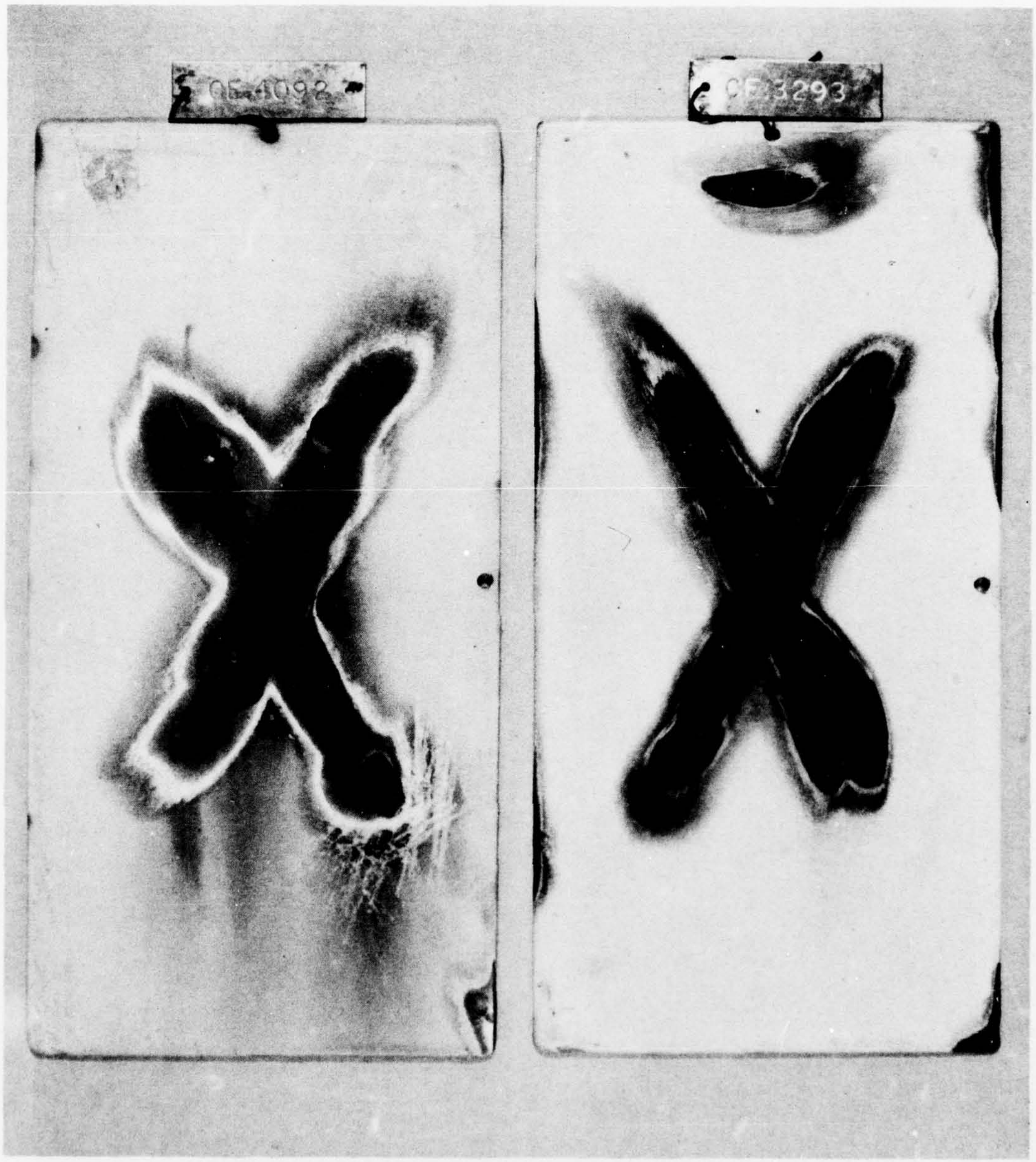

Figure 2. Wire-brushed, weathered paint panels (left to right, Systems II and I).

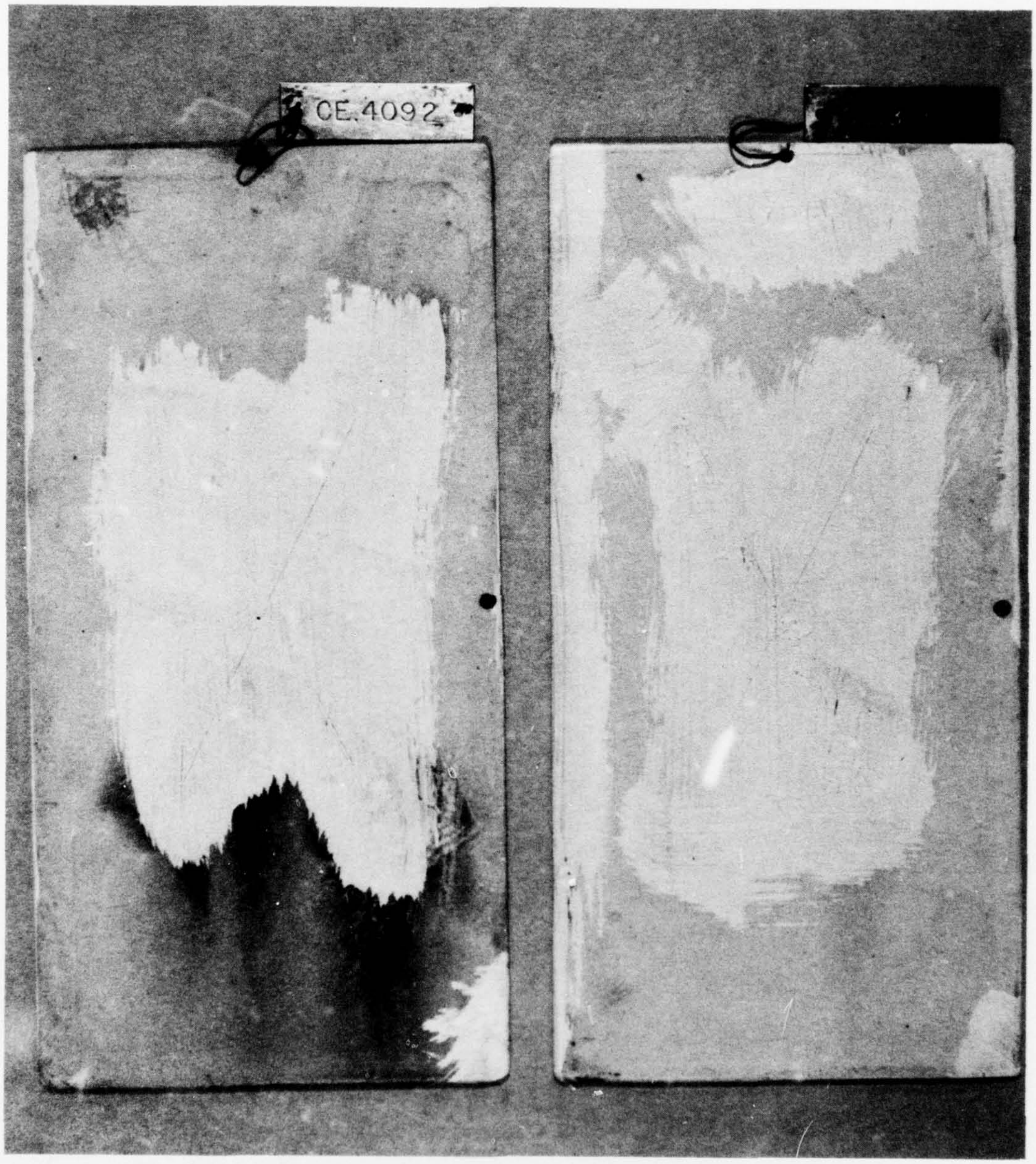

Figure 3. Spot-primed, weathered paint panels (left to right, Systems II and I).

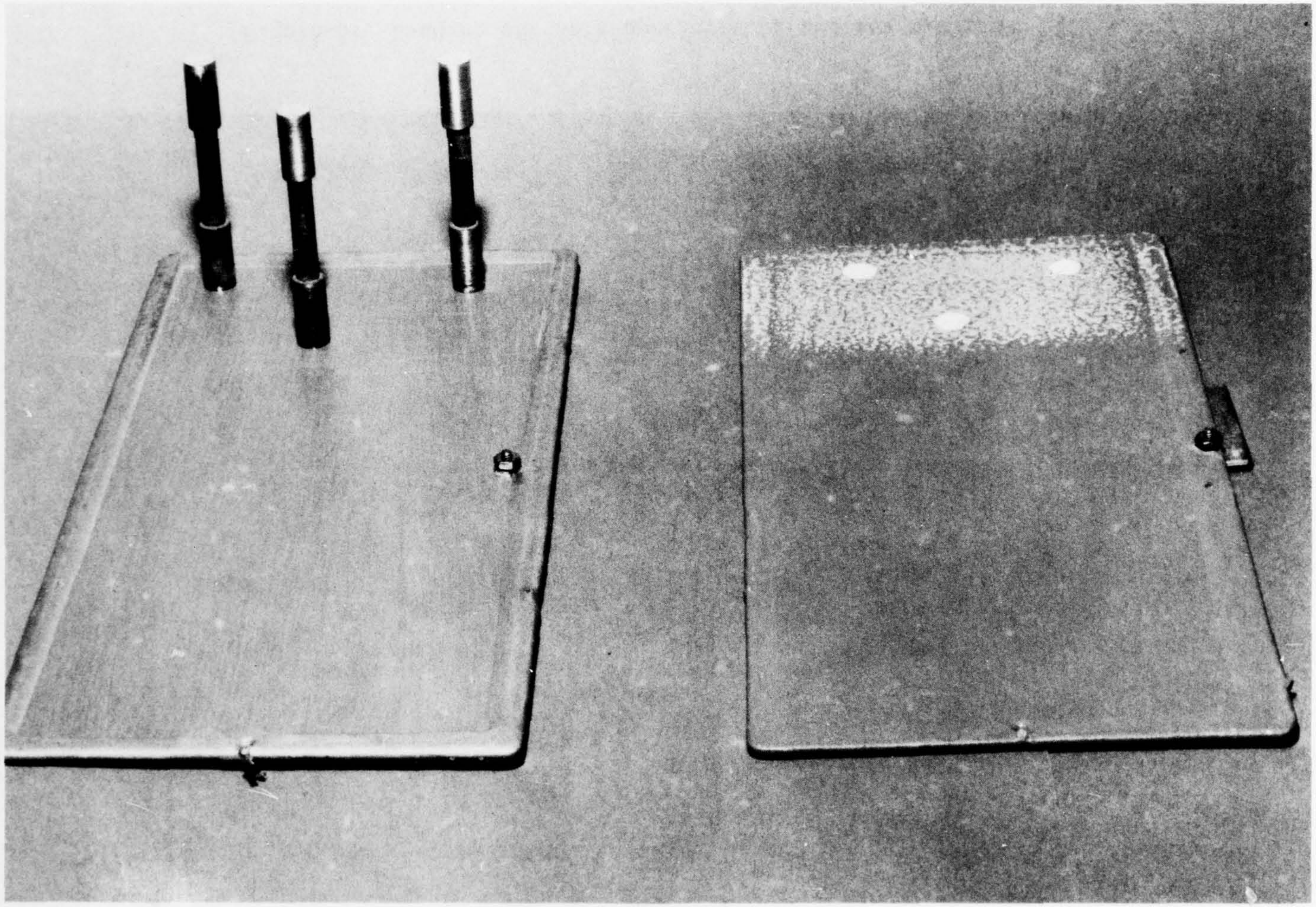

Figure 4. Painted panels before and after steel probes attached for bonding strength test.

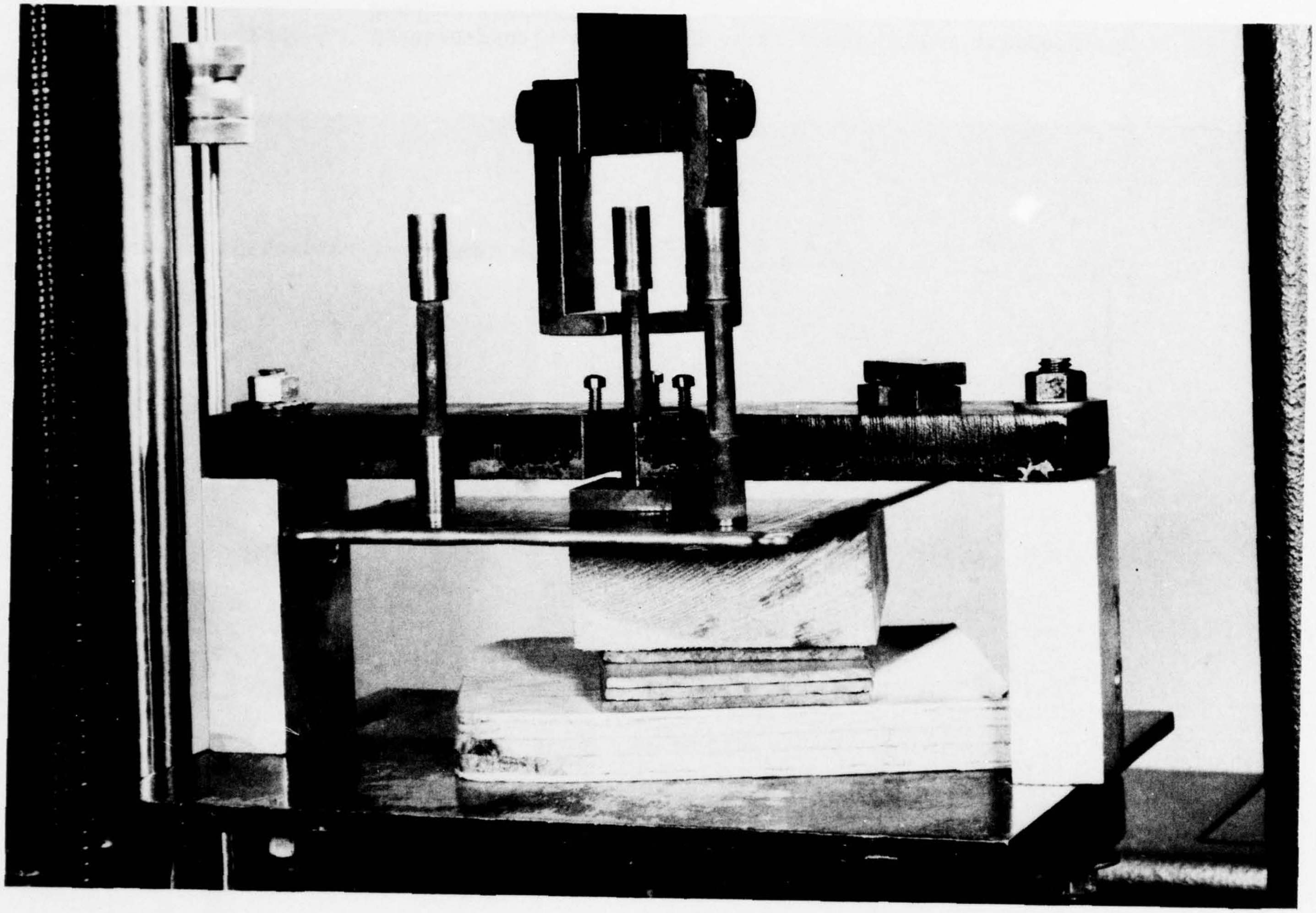

Figure 5. Bonding strength specimens in testing machines.

Figure 6. Experimental panels on exposure rack at Kwajalein Missile Range, Marshall Islands.

Figure 7. Experimental panels after 3 yr of exposure at Kwajalein Missile Range, Marshall Islands.

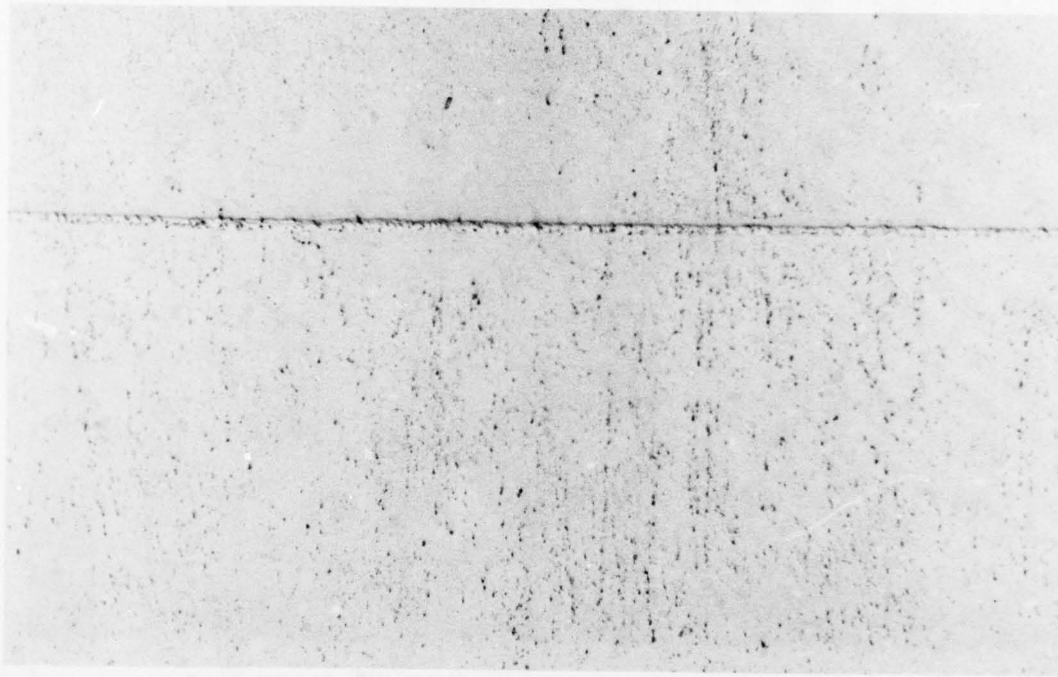

Figure 8. Pinpoint rusting on coated water tank exterior at San Nicolas Island.

Figure 9. Brush-priming of Plot II.

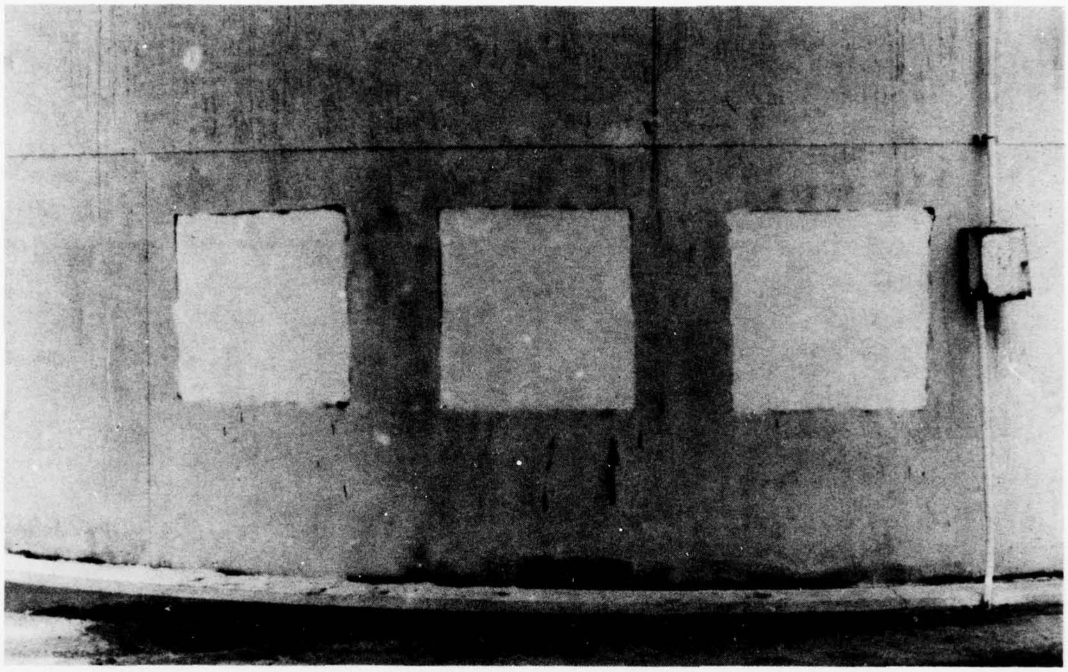

Figure 10. Tank plots immediately after topcoating.

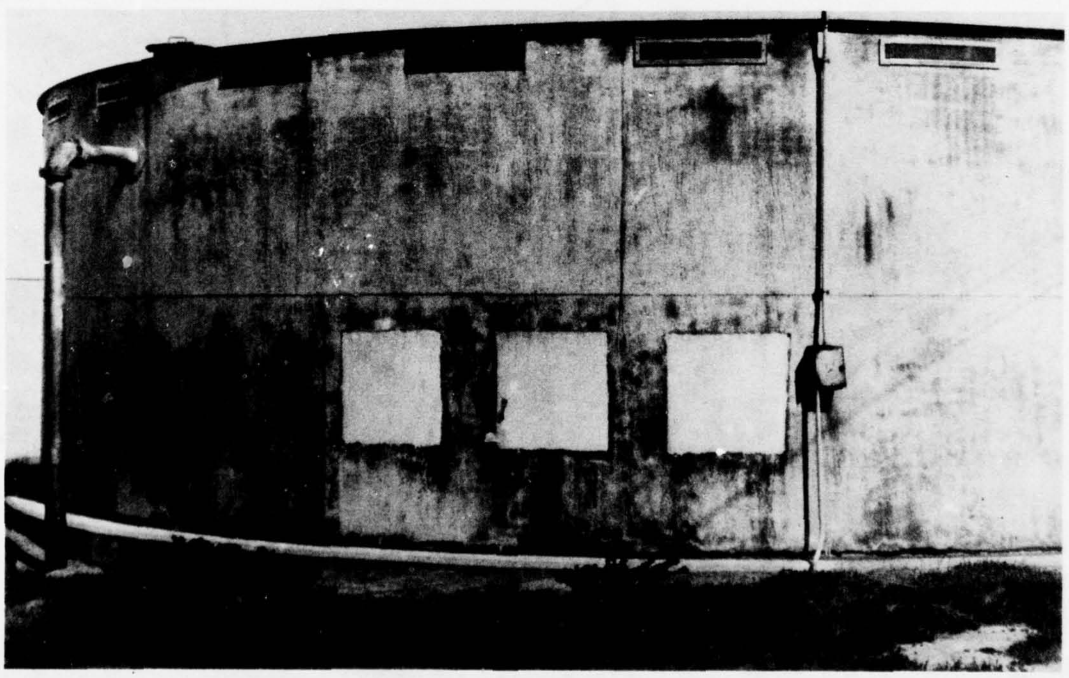

Figure 11. Tank plots after 1-1/2 yr exposure.

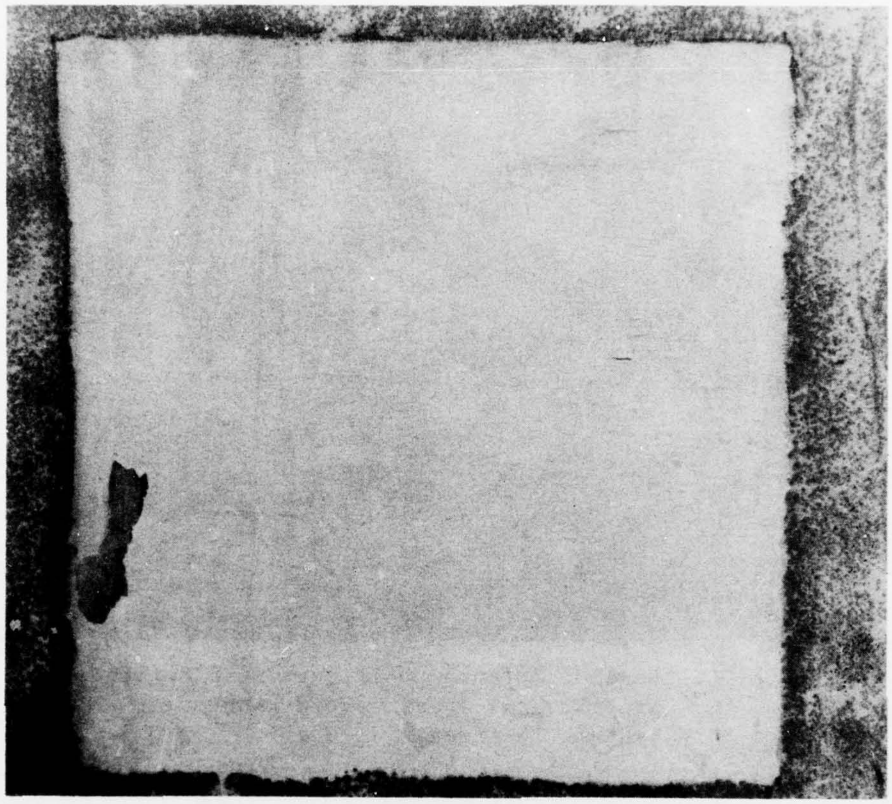

Figure 12. Plot II (System 8) after 1-1/2 yr exposure.

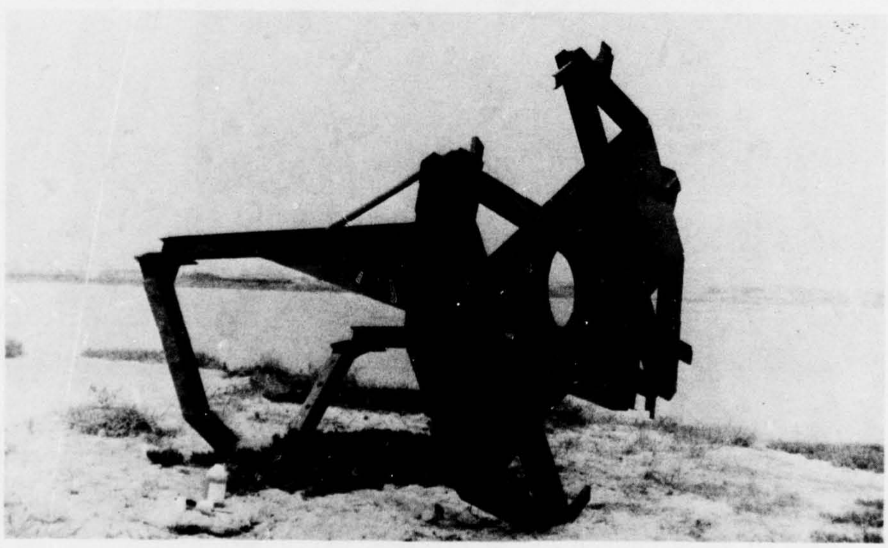

Figure 13. Antenna positioner at PMR after treatment of lower half of base with manganese-phosphalten no. 7.

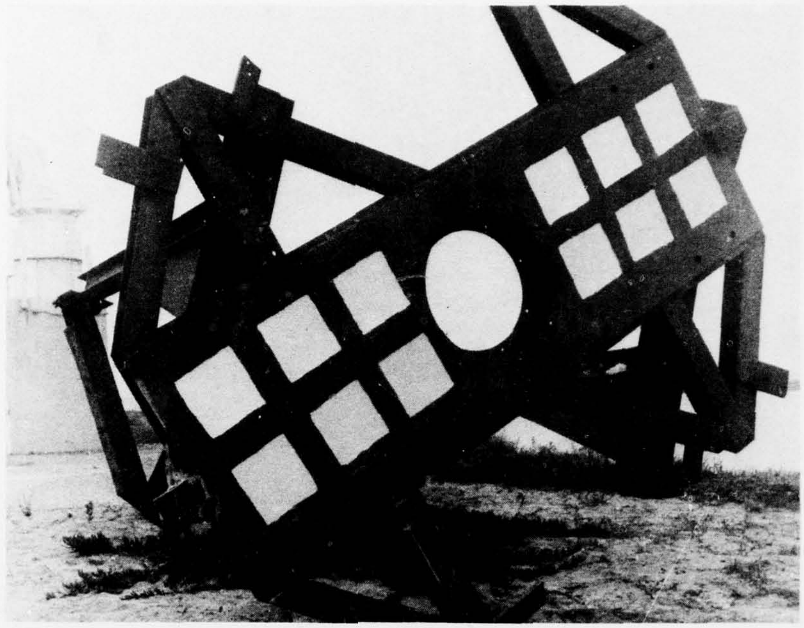

Figure 14. Base of antenna positioner with twelve experimental areas coated with paint systems 10 through 21.

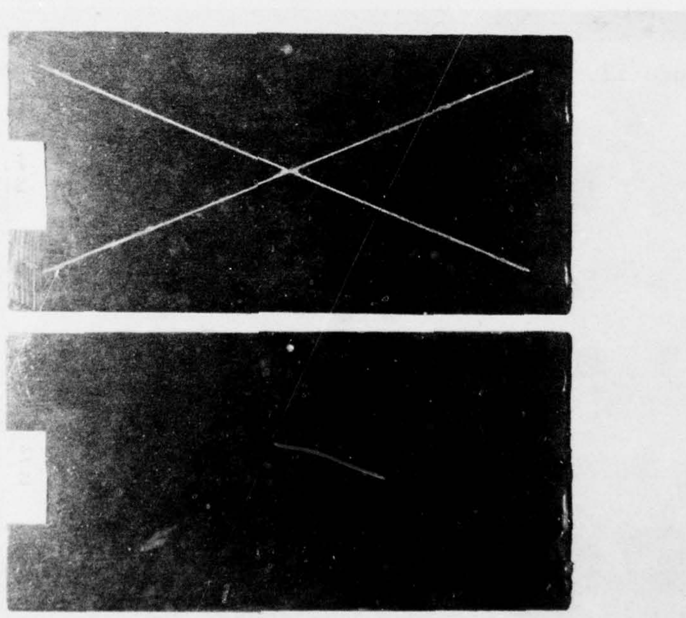

Figure 15. Untreated panel with ultraviolet-cured coating (System 42) before salt spray exposure.

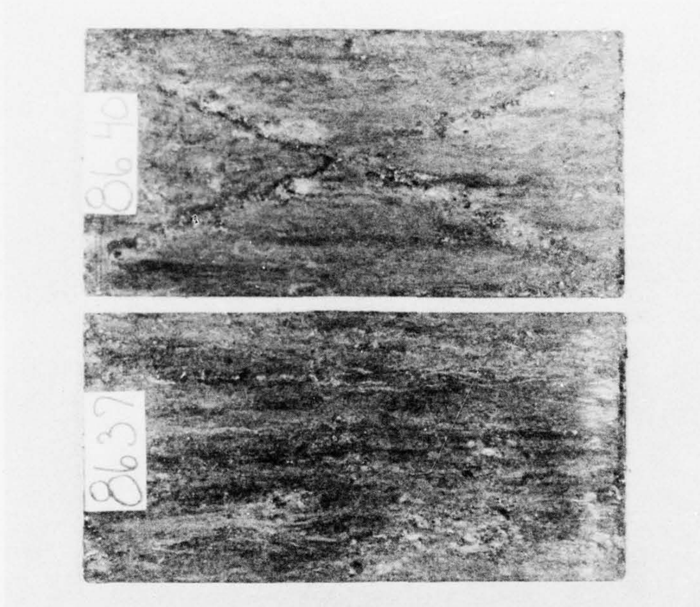

Figure 16. Untreated panel with ultraviolet-cured coating (System 42) after salt spray exposure.

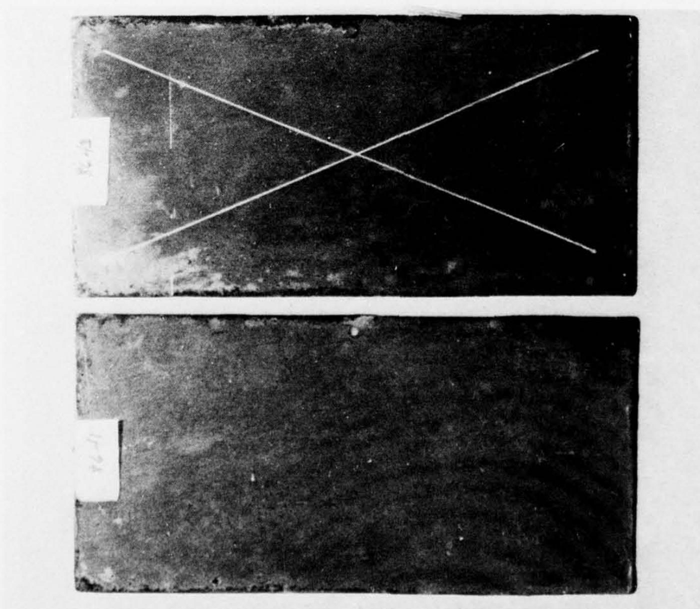

Figure 17. Treated panel with ultraviolet-cured coating (System 43) before salt spray exposure.

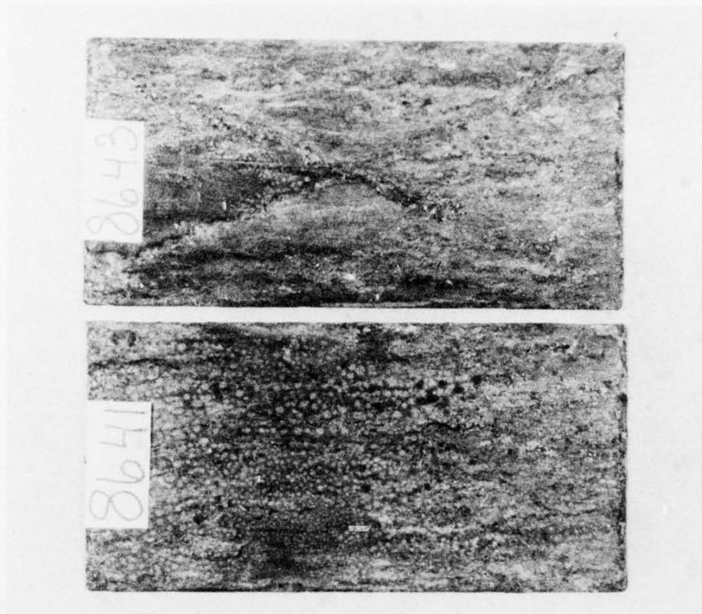

Figure 18. Treated panel with ultraviolet-cured coating (System 43) after salt spray exposure.

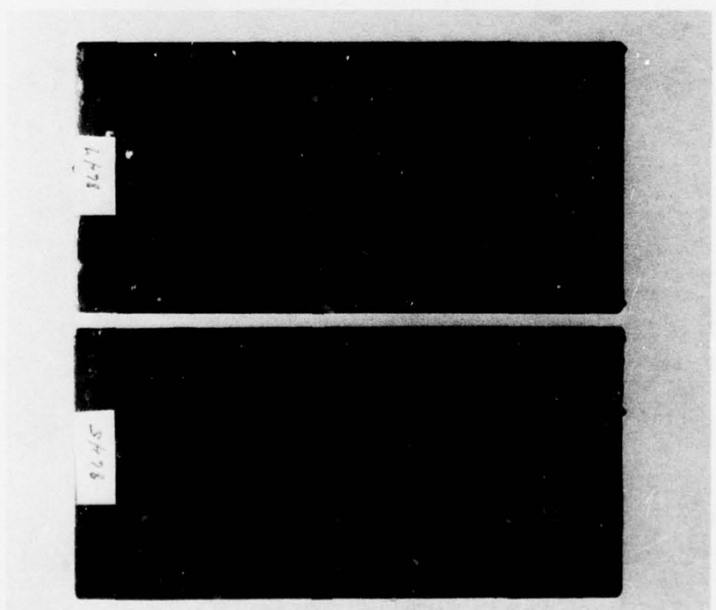

Figure 19. Untreated panel, CEL underwater epoxy (System 44), before salt spray exposure.

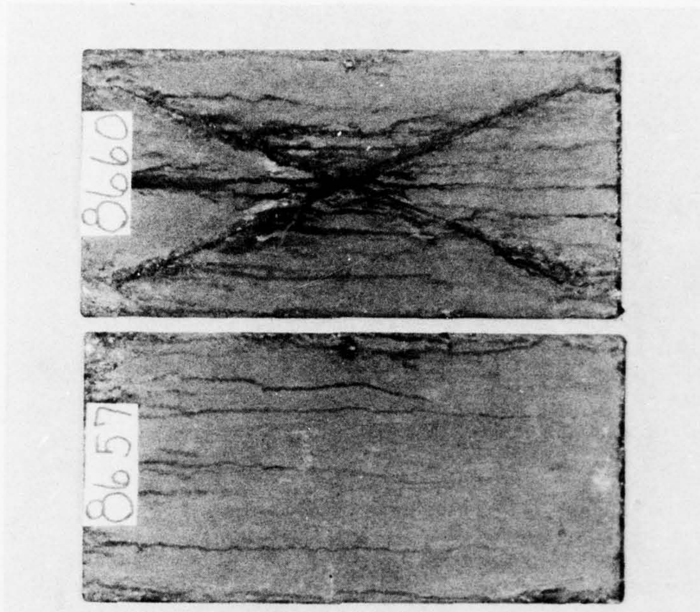

Figure 20. Untreated panel, CEL underwater epoxy (System 44), after salt spray exposure.

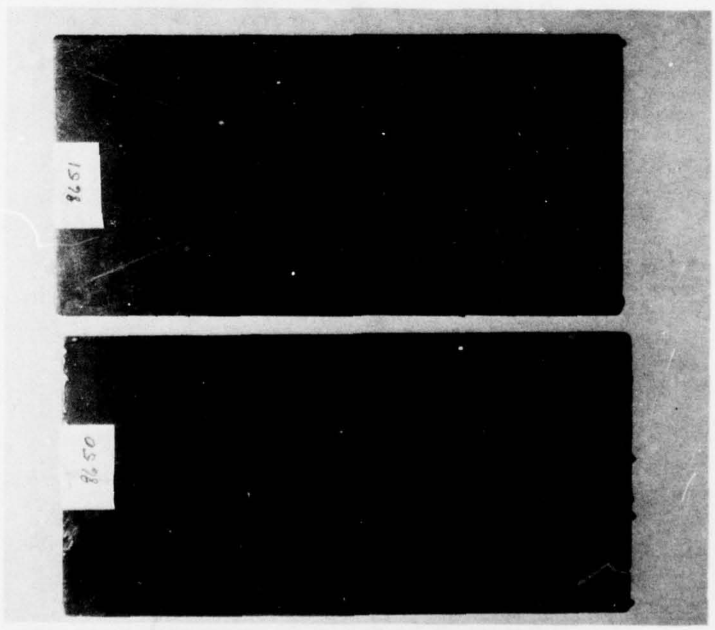

Figure 21. Treated panel, CEL underwater epoxy (System 45), before salt spray exposure.

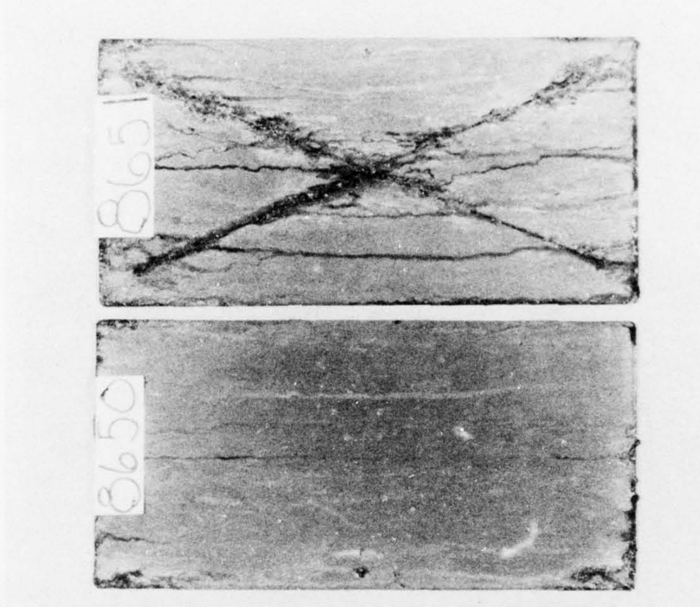

Figure 22. Treated panel, CEL underwater epoxy (System 45), after salt spray exposure.

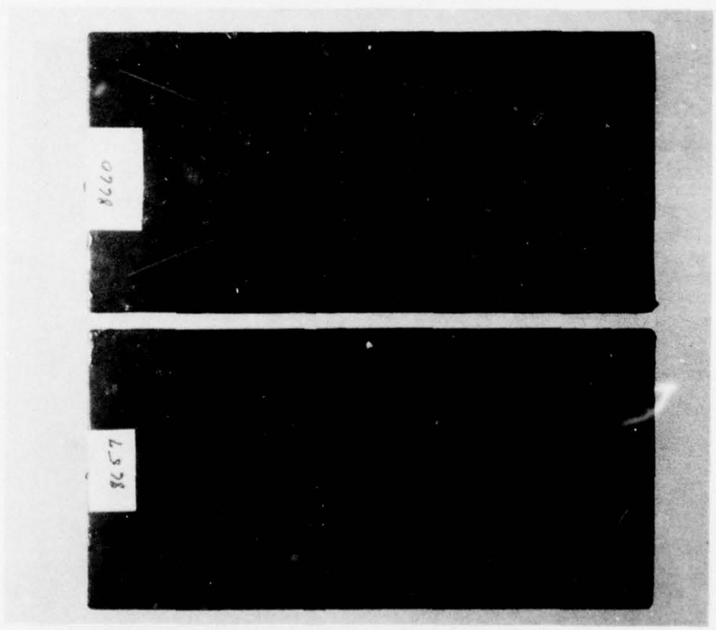

Figure 23. Untreated panel, CEL underwater epoxy (System 46) with organotin, before salt spray exposure.

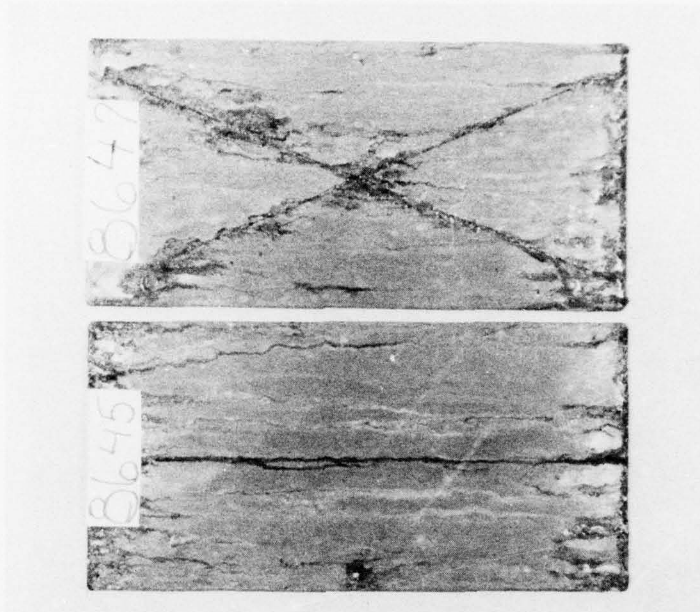

Figure 24. Untreated panel, CEL underwater epoxy (System 46) with organotin, after salt spray exposure.

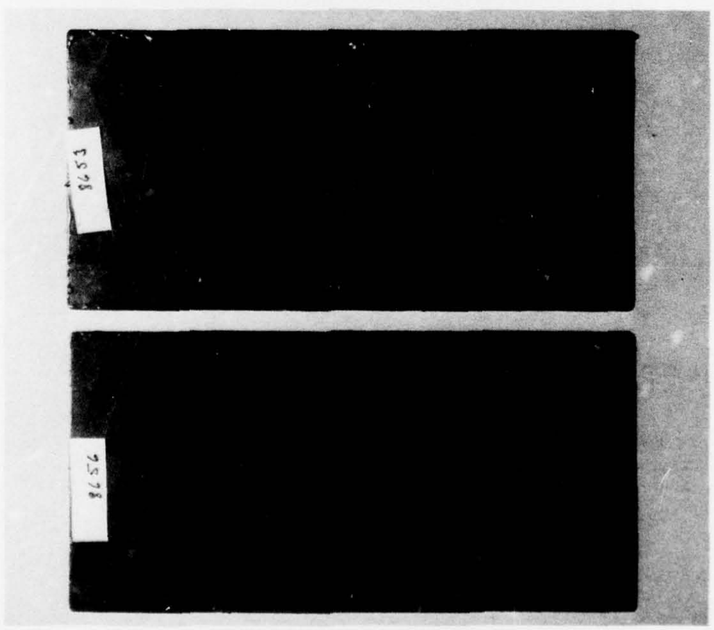

Figure 25. Treated panel, CEL underwater epoxy (System 47) with organotin, before salt spray exposure.

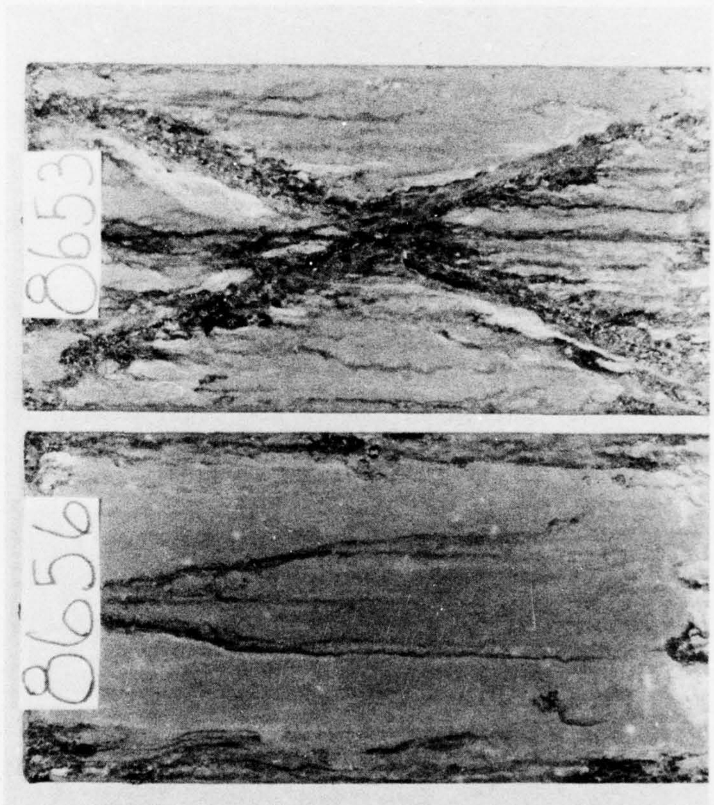

Figure 26. Treated panel, CEL underwater epoxy (System 47) with organotin, after salt spray exposure.

Table 1. Design of Experiment on Epoxy Coatings Showing Numbers of Panels, Methods of Surface Preparation, and Coating Application

Test Coating System		Sandblasted Steel	Weathered[a] System I	Weathered[a] System II	Weathered[a] System III	Total for System	Application Method
Description	Designation						
Water-Emulsion Epoxy	1[b]	2	2	2	1	7	sprayed
Water-Emulsion Epoxy	2[c]	2	2	2	1	7	sprayed
Water-Emulsion Epoxy	3[b]	2	2	2	1	7	sprayed
Low Solvent Epoxy	4	2	2	2	1	7	brushed
Regular Solvent Epoxy	5	2	2	2	1	7	sprayed
TT-P-489/TT-P-645/ MIL-P-15328	6	2	2	2	0[d]	6	sprayed
TOTALS		12	12	12	5	41	–

[a]Power wire-brushed, spot-primed with TT-P-645.

[b]Water-emulsion epoxies 1 and 3 were polyamide-cured.

[c]Water-emulsion epoxy 2 was polyamine-cured.

[d]No panels available.

Table 2. Identification and Thickness of Each Coat on Sandblasted Steel Panels

Coating System	Dry Film Thickness of Individual Coatings (mil)[a, b]			Total Dry Film Thickness (mils)
	Primer	Intermediate	Topcoat	
1	2	2	2-1/2+ 2-1/2	9
2	4	–	4-1/2+ 4-1/2	13
3	3-1/2	–	3-1/2+ 3-1/2	10-1/2
4	3-1/2+ 3-1/2+ 3	–		10
5	2	–	3-1/2+ 4	9-1/2
6	1/2	2-1/2	3+ 3	9

[a]Thickness measurements were made with magnetic gages.

[b]See Appendix B for identification and source of individual coatings.

Table 3. General Protection Ratings for Three Years at Half-Year Intervals

Substrate Condition	Protection Ratings for Following Number of Years—					
	1/2	1	1-1/2	2	2-1/2	3
System 1, Water-Emulsion Epoxy						
Sandblasted Steel	8+; 8+	8 ; 8	8- ; 8	8- ; 8	7 ; 7	5 ; 5
Weathered System I	8+; 9-	8+ ; 8+	8 ; 8+	8 ; 8	8 ; 8	8- ; 8
Weathered System II	8+; 8+	8 ; 8	8 ; 8	8 ; 8	8 ; 8	8- ; 8-
Weathered System III	9-	8+	8+	8+	8+	8
System 3, Water-Emulsion Epoxy						
Sandblasted Steel	8- ; 8-	7 ; 7	6 ; 6	4 ; 4	2 ; 2	2 ; 2
Weathered System I	9+; 9+	9 ; 9	9 ; 9-	9 ; 9-	8 ; 8	8- ; 8-
Weathered System II	9 ; 9	8+; 8+	8+; 8+	8+; 8	8 ; 8	8- ; 7
Weathered System III	9	8+	8+	8	8-	6
System 4, Low Solvent Epoxy						
Sandblasted Steel	9 ; 9	8+; 8+	8+; 8+	8 ; 8	8 ; 8	8- ; 8-
Weathered System I	10; 9+	9+; 9	9+; 9	9 ; 9-	9 ; 8+	8+; 8+
Weathered System II	9+; 9+	9 ; 9	9 ; 9	9- ; 9-	8+; 8	8+; 8-
Weathered System III	10	9+	9+	9-	8+	8
System 5, Regular Solvent Epoxy						
Sandblasted Steel	8 ; 8	7 ; 7	6 ; 7-	4 ; 4	2 ; 2	2 ; 2
Weathered System I	9 ; 9+	8+; 9+	8+; 9	8 ; 9-	8 ; 8+	8 ; 8
Weathered System II	9+; 8+	9 ; 8+	9 ; 8	9 ; 8	8 ; 8	8 ; 8
Weathered System III	9+	9-	9-	8+	8	8-
System 6, TT-E-489/TT-P-645/MIL-P-15328						
Sandblasted Steel	8 ; 8	8 ; 8	8 ; 8	8 ; 8-	8- ; 8-	7 ; 6
Weathered System I	9+; 9-	9- ; 9-	9- ; 9-	9- ; 8+	8+; 8	8 ; 8-
Weathered System II	9 ; 9	9- ; 9-	9- ; 8+	8 ; 8+	8 ; 8	8- ; 8
Weathered System III	—	—	—	—	—	—

Table 4. Bonding Strength of Unexposed Coating Systems[a]

Coating Systems	Bonding Strength (kg/sq cm) for Following–			
	Sandblasted Steel	Weathered System I	Weathered System II	Weathered System III
1, Water-Emulsion Epoxy[b]	42.0; 39.5; 34.5 54.5; 41.5; 59.0	64.0; 90.5; 64.5 43.5; 63.5; 62.0	60.5; 59.0; 61.5 60.5; 55.5; 52.5	37.0; 38.5; 38.5
2, Water-Emulsion Epoxy[c]	0.5; 1.0; 1.0 1.0; 1.5; 1.0	0.5; 0.5; 1.0 0.5; 0.5; 1.0	0.5; 1.0; 1.5 0.5; 0.5; 0.5	0.5; 0.5; 0.5
3, Water-Emulsion Epoxy[b]	40.0; 32.0; 47.0 43.0; 40.0; 48.0	108.0; 80.0; 92.5 47.0; 56.0; 119.0	50.0; 49.0; 54.0 68.5; 56.5; 68.5	70.0; 62.0; 52.0
4, Low Solvent Epoxy	19.5; 15.0; 12.0 14.0; 16.0; 18.0	40.5; 56.5; 46.5 73.0; 51.0; 80.0	48.0; 68.5; 52.0 46.0; 52.0; 37.0	34.0; 24.0; 24.5
5, Regular Solvent Epoxy	37.0; 46.0; 48.0 34.5; 44.5; 59.0	66.5; 54.5; 59.0 90.0; 102.0; 109.0	63.0; 61.0; 65.5 98.5; 76.5; 67.5	58.5; 51.5; 63.5
6, TT-P-489/TT-P-645/ MIL-P-15328[d]	9.0; 8.0; 8.0 7.0; 4.5; 8.5	27.5; 19.5; 22.0 30.5; 31.5; 28.0	20.5; 26.5; 24.0 21.5; 21.5; 17.5	–[e]

[a]Three steel probes were pulled from two sandblasted and Weathered Systems I and II panels, but from only one of the Weathered System III panels.

[b]Polyamide-cured.

[c]Polyamine-cured.

[d]All System 6 panels failed by delamination of coats; all others had cohesive failure of the entire paint system.

[e]No Weathered System III panel was available for coating System 6.

Table 5. Bonding Strength of Back Side of Coating Systems After 3-yr Exposure

Coating Systems	Bonding Strength (kg/sq cm) for Following–			
	Sandblasted Steel	Weathered System I	Weathered System II	Weathered System III
1, Water-Emulsion Epoxy	24.7; 24.0; 25.5 24.3; 24.1; 15.0	70.0; 91.5; 76.0 80.0; 72.0; 73.0	57.5; 88.5; 85.1 105.0; 90.0; 58.0	23.8; 16.7; 22.2
3, Water-Emulsion Epoxy	28.0; 18.5; 25.0 41.3; 32.4; 32.2	70.0; 54.5; 38.0 58.5; 60.5; 48.0	61.5; 91.5; 62.5 59.0; 50.0; 60.1	65.0; 57.0; 54.0
4, Low Solvent Epoxy	16.8; 12.8; 15.6 14.5; 7.5; 15.4	21.0; 22.8; 18.4 19.5; 21.5; 21.0	25.5; 24.5; 25.0 19.5; 23.8; 35.5	9.6; 17.5; 18.8
5, Regular Solvent Epoxy	61.7; 36.5; 27.2 30.5; 36.2; 27.2	45.5; 41.3; 48.0 36.3; 41.2; 35.4	95.0; 77.0; 45.0 82.8; 43.8; 47.6	50.0; 93.4; 58.6
6, TT-P-489/TT-P-645/ MIL-P-15328	18.5; 27.7; 28.6 38.5; 45.0; 33.0	66.4; 55.5; 35.0 49.7; 68.0; 42.5	65.0; 48.0; 44.0 55.0; 33.0; 37.0	–

Table 6. Bonding Strength of Front Side of Coating Systems After 3-yr Exposure

Coating Systems	Bonding Strength (kg/sq cm) for Following–			
	Sandblasted Steel	Weathered System I	Weathered System II	Weathered System III
1, Water Emulsion Epoxy	18.3; 16.4; 15.2 40.0; 11.2; 11.2	57.5; 39.5; 49.5 62.0; 65.0; 88.0	40.0; 52.0; 43.0 41.0; 61.0; 40.0	25.0; 28.2; 21.0
3, Water Emulsion Epoxy	23.5; 26.0; 25.0 25.0; 26.7; 15.2	47.2; 65.0; 46.5 37.0; 38.5; 75.0	48.5; 60.0; 54.0 59.5; 36.2; 40.4	41.0; 27.0; 55.0
4, Low Solvent Epoxy	17.3; 16.5; 14.2 16.4; 15.0; 21.2	30.0; 21.3; 29.4 40.3; 40.5; 26.4	39.6; 24.8; 44.0 68.0; 17.7; 75.0	26.8; 29.5; 18.5
5, Regular Solvent Epoxy	27.0; 26.3; 21.8 29.5; 37.5; 36.3	95.0; 70.0; 55.0 24.0; 30.4; 39.7	68.0; 45.0; 45.0 54.0; 42.0; 44.5	39.8; 38.2; 47.0
6, TT-P-489/TT-P-645/ MIL-P-15328	20.0; 17.3; 17.8 41.6; 37.7; 42.0	47.0; 34.0; 51.0 58.0; 49.0; 34.0	50.0; 32.0; 43.0 33.0; 53.0; 36.0	

Table 7. Average of Three Bonding Strengths Determined Originally (Before Exposure) and on Backs and Fronts of Panels After 3-yr Exposure

Coating System	Average Bonding Strengths (kg/sq cm) for Following–											
	Sandblasted Steel			Weathered System I			Weathered System II			Weathered System III		
	Original	Back	Front	Original	Back	Front	Original	Back	Front	Original	Back	Front
1, Water-Emulsion Epoxy	38.7; 51.7	24.7; 21.1	16.6; 20.8	73.0; 56.3	79.2; 75.0	48.8; 71.7	60.3; 56.2	77.0; 84.3	45.0; 47.3	38.0	20.9	24.7
3, Water-Emulsion Epoxy	39.7; 43.7	23.8; 35.3	24.8; 22.3	93.5; 74.0	54.2; 55.7	52.9; 50.1	51.0; 64.5	71.8, 56.4	54.2; 45.4	61.3	58.7	41.0
4, Low Solvent Epoxy	15.5; 16.0	15.1; 12.5	16.0; 17.5	47.8; 68.0	20.7; 20.7	26.9; 35.7	56.2; 45.0	25.0; 26.3	36.1; 53.6	27.5	15.3	24.9
5, Regular Solvent Epoxy	43.7; 46.0	41.8; 31.3	25.0; 34.4	60.0; 100.3	44.9; 37.6	73.3; 31.4	63.2; 80.8	72.3; 58.1	52.7; 46.8	57.8	67.3	41.7
6, TT-P-489/TT-P-645/ MIL-P-15328	8.3; 6.7	24.9; 38.8	18.4; 40.4	23.0; 30.0	52.3; 53.4	44.0; 47.0	23.7; 20.2	52.3; 41.7	41.7; 40.7	–	–	–

Table 8. Identification of Coating Systems Used at San Nicolas, PMR, and Salt Spray Exposure

System No.	Primer	Topcoat	Surface Treatment[b]	Dry Film Thickness (mil)
San Nicolas Island Exposure				
7	Epoxy amine-cured	Epoxy polyamide-cured	2	14
8	Epoxy	Epoxy polyamide-cured	1	14
9	Epoxy amine-cured	Epoxy polyamide-cured	1	14
PMR, Point Mugu Exposure				
10	Epoxy amine-cured	MIL-P-24441-152[a]	1	8 to 9
11	Epoxy amine-cured	MIL-P-24441-152[a]	1	4 to 5
12	MIL-P-24441-150[a]	MIL-P-24441-152[a]	1	8 to 10
13	Epoxy amine-cured	MIL-P-24441-152[a]	2	7 to 8
14	Epoxy amine-cured	MIL-P-24441-152[a]	2	4 to 5
15	MIL-P-24441-150[a]	MIL-P-24441-152[a]	2	6 to 8
16	Epoxy amine-cured	Epoxy polyamide-cured	1	8 to 10
17	Epoxy-polyester	Epoxy polyamide-cured	1	7 to 9
18	MIL-P-24441-150[a]	Epoxy polyamide-cured	1	8 to 10
19	Epoxy amine-cured	Epoxy polyamide-cured	2	10 to 12
20	Epoxy-polyester	Epoxy polyamide-cured	2	7 to 9
21	MIL-P-24441-150[a]	Epoxy polyamide-cured	2	7 to 10
22	CEL epoxy without organotin additive	MIL-P-24441-152[a]	1	7 to 12
23	CEL epoxy with organotin additive	MIL-P-24441-152[a]	1	8 to 11
24	Ultraviolet curing coating	MIL-P-24441-152[a]	1	15 to 21
25	CEL epoxy without organotin additive	MIL-P-24441-152[a]	2	8 to 10
26	CEL epoxy with organotin additive	MIL-P-24441-152[a]	2	11 to 14
27	Ultraviolet curing coating	MIL-P-24441-152[a]	2	11 to 18
28	CEL epoxy without organotin additive	Epoxy polyamide-cured	1	8 to 11
29	CEL epoxy with organotin additive	Epoxy polyamide-cured	1	13 to 18
30	Ultraviolet curing coating	Epoxy polyamide-cured	1	17 to 19
31	CEL epoxy without organotin additive	Epoxy polyamide-cured	2	11 to 16
32	CEL epoxy with organotin additive	Epoxy polyamide-cured	2	11 to 15
33	Ultraviolet curing coating	Epoxy polyamide-cured	2	11 to 17
34	Zinc-zinc alloy in medium oil alkyd	MIL-P-24441-152[a]	1	6 to 8
35	Zinc-rich chlorinated rubber	Chlorinated rubber	1	8 to 12
36	Zinc-zinc alloy in medium oil alkyd	Epoxy polyamide-cured	1	8 to 12
37	Inorganic zinc rich	Acrylic	1	9 to 12
38	Zinc-rich chlorinated rubber	Chlorinated rubber	2	7 to 10
39	Inorganic zinc rich	Acrylic	2	8 to 15
40	Zinc-zinc alloy in medium oil alkyd	MIL-P-24441-152[a]	2	6 to 9
41	Zinc-zinc alloy in medium oil alkyd	Epoxy polyamide-cured	2	6 to 10
Salt Spray Exposure				
42	Ultraviolet curing paint	—	1	4
43	Ultraviolet curing paint	—	2	4
44	CEL underwater epoxy	—	1	12

continued

Table 8. Continued

System No.	Primer	Topcoat	Surface Treatment[b]	Dry Film Thickness (mil)
Salt Spray Exposure (Continued)				
45	CEL underwater epoxy	—	2	13
46	CEL epoxy with tin compound	—	1	13
47	CEL epoxy with tin compound	—	2	16
48	Ultraviolet curing paint	Silicone alkyd enamel	—	4
49	Ultraviolet curing paint	Epoxy polyamide-cured	—	6
50	Ultraviolet curing paint	Medium length alkyd enamel	—	5
51	Ultraviolet curing paint	Phenolic silicone alkyd enamel	—	5
52	Ultraviolet curing paint	Alkyd enamel	—	5
53	Ultraviolet curing paint	—	—	4

[a] MIL-P-24441 is epoxy polyamide-cured.

[b] 1 = Hand wire-brushed.
2 = Hand wire-brushed, treated with manganesed-phospholene No. 7.

Table 9. Ratings of Coated Areas on Antenna Positioner After 3 Months

[General protection rating for all systems was 10.]

Test Section No.	Discoloration	Chalking	Checking	Peeling	Rusting, Type I	Blistering	Remarks
10	10^{-}	10	10	10	10	10	
11	9	10	10	10	10	10	
12	9	10	10	10	10	10	
13	10^{-}	10	10	10	10	10	
14	9	10	10	10	10	10	
15	9	10	10	10	10	10	
16	9	10	10	10	10	10	
17	8	10	10	10	10	10	
18	9^{-}	10	10	10	10	10	
19	9^{-}	10	10	10	10	10	
20	8	10	10	10	10	10	
21	8	10	10	10	10	10	
22	9^{-}	10	10	10	10	10	Spotting
23	9^{-}	10	10	10	10	10	
24	9^{-}	10	10	10	10	10	
25	9	10	10	10	10	10	
26	9	10	10	10	10	10	
27	9·	10	10	10	10	10	
28	9^{-}	10	10	10	10	10	
29	9^{-}	10	10	10	10	10	
30	9^{-}	10	10	10	10	10	
31	9	10	10	10	10	10	
32	9	10	10	10	10	10	
33	9	10	10	10	10	10	
34	9/6	10	10	10	10	10	
35	9/6	10	10	10	10	10	Wrinkling
36	9/6	10	10	10	10	10	Wrinkling
37	9/6	10	10	10	10	10	
38	9	10	10	10	10	10	Wrinkling
39	9	10	10	10	10	10	Wrinkling
40	9	10	10	10	9	10	Wrinkling
41	9	10	10	10	10	10	Wrinkling

Table 10. Panel Ratings of Coating Systems 42 Through 47 After

[Refer to Remarks column for each asterisked iter

Exposure (days)	Panel	Rating for Following Properties –								
		General Protection	Discoloration	Chalking	Alligatoring, Checking, Cracking	Scaling, Flaking, Peeling	Rusting Type I	Rusting Type II	Tuberculation	Rusti Scrib
System 42										
10	1	10	10	10	10	10	10	10		
	2	10	10	10	10	10	10	10		
	3	10	10	10	10	10	10	10	L/S	L
	4	10	10	10	10	10	10	10	L/S	L
27	1	10	—	—	10	10	9	10		
	2	10	—	—	10	10	9	10		
	3	9+	*	—	10	10	9	10	L/S	L
	4	9+	*	—	10	10	9	10	L/S	L
54	1	10−	—	—	10	10	10	9		
	2	10−	—	—	10	10	10	9		
	3	9	—	—	10	10	8	9	M/S	L
	4	9	—	—	10	10	8	9	M/S	L
86	1	10−	*	—	10	10	9	10		
	2	10−	*	—	10	10	9	10		
	3	10	*	—	10	10	9	10	M/S	M
	4	10	*	—	10	10	9	10	M/S	M
104	1	9	*	10	10	10	9	9		
	2	9	*	10	10	10	9	9		
	3	7	*	10	10	10	8	8	H/S	H
	4	7	*	10	10	10	8	8	H/S	H
131	1	8	*	10	10	10	9	9		
	2	8	*	10	10	10	9	9		
	3	6	*	10	10	10	8	8	H/S	H
	4	6	*	10	10	10	8	8	H/S	H
180	1	7	*	10	10	10	9	9		
	2	7	*	10	10	10	9	9		
	3	5	*	10	10	10	8	8	H/S	H
	4	5	*	10	10	10	8	8	H/S	H
System 43										
10	1	10	10	10	10	10	10	10		
	2	10	10	10	10	10	10	10		
	3	10	10	10	10	10	10	10	L/S	L
	4	10	10	10	10	10	10	10	L/S	L
27	1	10	—	—	10	10	10	10		
	2	10	—	—	10	10	10	10		
	3	9+	*	—	10	10	9	10	L/S	M
	4	9+	*	—	10	10	9	10	L/S	M

NOTE: Meaning of abbreviations –

VL = very light M = medium F = few O/L = light rusting in scribe L/S = light tuberculat
S = slight H = heavy D = dense O/M = medium rusting in scribe M/S = medium tuberc

10. Panel Ratings of Coating Systems 42 Through 47 After 5% Salt Spray Exposure

[Refer to Remarks column for each asterisked item.]

Rating for Following Properties –									Remarks
Scaling, Flaking, Peeling	Rusting		Tuberculation	Rusting Scribe	Blistering	Undercutting	Blistering Scribe	Dry Film Thickness (mils)	
	Type I	Type II							
System 42									
10	10	10			10	10		3	
10	10	10			10	10		4	
10	10	10	L/S	L	10	10	10	4	
10	10	10	L/S	L	10	10	10	5	
10	9	10			10	10			
10	9	10			10	10			
10	9	10	L/S	L	10	10	—		Rust stain from scribe.
10	9	10	L/S	L	10	10	—		Rust stain from scribe.
10	10	9			8/F*	10			Top edge.
10	10	9			8/F*	10			Top edge.
10	8	9	M/S	L	8/F	10	10		
10	8	9	M/S	L	8/F	10	10		
10	9	10			10	10			Rust stain from top edge.
10	9	10			10	10			Rust stain from top edge.
10	9	10	M/S	M	10	10	10		Rust stain from top edge and scribe.
10	9	10	M/S	M	10	10	10		Rust stain from top edge and scribe.
10	9	9			8	10			Rust stain from top edge and hole.
10	9	9			8	10			Rust stain from top hole.
10	8	8	H/S	H	8	10	10		Rust stain from top hole and scribe.
10	8	8	H/S	H	8	10	10		Rust stain from top hole and scribe.
10	9	9			8	10			Rust stain from top edge and hole.
10	9	9			8	10			Rust stain from top hole.
10	8	8	H/S	H	8	10	10		Rust stain from top hole and scribe.
10	8	8	H/S	H	8	10	10		Rust stain from top hole and scribe.
10	9	9			5	10			Rust stain from top edge and hole.
10	9	9			8	10			Rust stain from top hole.
10	8	8	H/S	H	8	10	10		Rust stain from top hole and scribe.
10	8	8	H/S	H	8	10	10		Rust stain from top hole and scribe.
System 43									
10	10	10			10	10		5	
10	10	10			10	10		5	
10	10	10	L/S	L	10	10	10	4	
10	10	10	L/S	L	10	10	10	3	
10	10	10			10	10			
10	10	10			10	10			
10	9	10	L/S	M	10	10	—		Rust stain from scribe.
10	9	10	L/S	M	10	10	—		Rust stain from scribe.

continued

O/L = light rusting in scribe
O/M = medium rusting in scribe
L/S = light tuberculation in scribe
M/S = medium tuberculation in scribe
H/S = heavy tuberculation in scribe

Table 10. Continued

[Refer to Remarks column for each asterisked item.]

Exposure (days)	Panel	General Protection	Discoloration	Chalking	Alligatoring, Checking, Cracking	Scaling, Flaking, Peeling	Rusting		Tuberculation	Rusting Scribe
							Type I	Type II		
System 43 (continued)										
54	1	10^{-}	—	—	10	10	9	10		
	2	10^{-}	—	—	10	10	9	10		
	3	9	—	—	10	10	10	10	M/S	M
	4	9	—	—	10	10	10	10	M/S	M
86	1	9^{-}	*	—	10	10	9	8		
	2	9	*	—	10	10	9	9		
	3	8^{+}	*	—	10	10	9	9	M/S	H
	4	8^{-}	*	—	10	10	9	8	M/S	H
104	1	9	*	10	10	10	7	7		
	2	9	*	10	10	10	7	7		
	3	7	*	10	10	10	8	8	H/S	H
	4	7	*	10	10	10	8	8	H/S	H
131	1	8	*	10	10	10	7	7		
	2	8	*	10	10	10	7	7		
	3	6	*	10	10	10	8	8	H/S	H
	4	6	*	10	10	10	8	8	H/S	H
180	1	7	*	10	10	10	7	7		
	2	7	*	10	10	10	7	7		
	3	5	*	10	10	10	8	8	H/S	H
	4	5	*	10	10	10	8	8	H/S	H
System 44										
10	1	10	10	10	10	10	10	10		
	2	10	10	10	10	10	10	10		
	3	10	10	10	10	10	10	10	10	8
	4	10	10	10	10	10	10	10	10	5
27	1	10	—	—	10	10	10	10		
	2	10	—	—	10	10	10	10		
	3	10	*	—	10	10	10	10	10	VL
	4	10	*	—	10	10	10	10	10	VL
54	1	10	—	—	10	10	10	10		
	2	10	—	—	10	10	10	10		
	3	10^{-}	—	—	10	10	10	10	10	VL
	4	10^{-}	—	—	10	10	10	10	10	L
86	1	10^{-}	*	—	10	10	9	10		
	2	10^{-}	*	—	10	10	9	10		
	3	10^{-}	*	—	10	10	9	10	10	VL
	4	10^{-}	*	—	10	10	9	10	10	L

NOTE: Meaning of abbreviations –

VL = very light M = medium F = few O/L = light rusting in scribe L/S = light tuberculation in

S = slight H = heavy D = dense O/M = medium rusting in scribe M/S = medium tuberculatior

Table 10. Continued

[Refer to Remarks column for each asterisked item.]

ng, ng, ng	Rating for Following Properties – Rusting Type I	Type II	Tuberculation	Rusting Scribe	Blistering	Undercutting	Blistering Scribe	Dry Film Thickness (mils)	Remarks
	System 43 (continued)								
	9	10			10	10			
	9	10			10	10			
	10	10	M/S	M	10	VL-S	10		
	10	10	M/S	M	10	VL-S	10		
	9	8			4/M	10			Rust stain, blistering is localized.
	9	9			2/F	10			Rust stain from top edge and hole.
	9	9	M/S	H	10	10	10		Rust stain from top edge and scribe.
	9	8	M/S	H	4/D	10	6/D		Rust stain from top edge and scribe.
	7	7			7	10			Rust stain from top edge and hole.
	7	7			7	10			Rust stain from top edge and hole.
	8	8	H/S	H	7	10	8		Rust stain from top hole and scribe.
	8	8	H/S	H	7	10	8		Rust stain from top hole and scribe.
	7	7			5	10			Rust stain from top edge and hole.
	7	7			5	10			Rust stain from top edge and hole.
	8	8	H/S	H	5	10	7		Rust stain from top hole and scribe.
	8	8	H/S	H	5	10	7		Rust stain from top hole and scribe.
	7	7			5	10			Rust stain from top edge and hole.
	7	7			5	10			Rust stain from top edge and hole.
	8	8	H/S	H	3	10	5		Rust stain from top hole and scribe.
	8	8	H/S	H	3	10	5		Rust stain from top hole and scribe.
	System 44								
	10	10			10	10		12	
	10	10			10	10		14	
	10	10	10	8	10	10	10	10	
	10	10	10	5	10	10	10	12	
	10	10			10	10			
	10	10			10	10			
	10	10	10	VL	10	10	—		Rust stain from scribe.
	10	10	10	VL	10	10	—		Rust stain from scribe.
	10	10			10	10			
	10	10			10	10			
	10	10	10	VL	10	10	10		
	10	10	10	L	10	10	10		
	9	10			10	10			Rust stain from top edge and hole.
	9	10			10	10			Rust stain from top edge and hole.
	9	10	10	VL	10	10	2/F		Rust stain from top edge and scribe.
	9	10	10	L	10	10	4/F		Rust stain from top edge and scribe.

continued

ght rusting in scribe L/S = light tuberculation in scribe H/S = heavy tuberculation in scribe
edium rusting in scribe M/S = medium tuberculation in scribe

2

Table 10. Continued

[Refer to Remarks column for each asterisked item.]

Exposure (days)	Rating for Following Properties –										
	Panel	General Protection	Discoloration	Chalking	Alligatoring, Checking, Cracking	Scaling, Flaking, Peeling	Rusting		Tuberculation	Rusting Scribe	Blis
							Type I	Type II			
System 44 (continued)											
104	1	10	*	10	10	10	9	10			1
	2	10	*	10	10	10	9	10			1
	3	10	*	10	10	10	9	10	10	VL	1
	4	10	*	10	10	10	9	10	10	VL	1
131	1	10	*	10	10	10	9	10			1
	2	10	*	10	10	10	9	10			1
	3	10	*	10	10	10	9	10	10	VL	1
	4	10	*	10	10	10	9	10	10	VL	1
180	1	10	*	10	10	10	9	10			1
	2	10	*	10	10	10	9	10			1
	3	10	*	10	10	10	9	10	10	VL	1
	4	10	*	10	10	10	9	10	10	VL	1
System 45											
10	1	10	10	10	10	10	10	10			1
	2	10	10	10	10	10	10	10			1
	3	10	10	10	10	10	10	10	10	8	1
	4	10	10	10	10	10	10	10	10	6	1
27	1	10	—	—	10	10	10	10			1
	2	10	—	—	10	10	10	10			1
	3	10	*	—	10	10	10	10	10	1/VL	1
	4	10	*	—	10	10	10	10	10	1/VL	1
54	1	10	—	—	10	10	10	10			1
	2	10	—	—	10	10	10	10			1
	3	10^-	—	—	10	10	10	10	VL/S	L	1
	4	10^-	—	—	10	10	10	10	VL/S	L	1
86	1	10^-	*	—	10	10	9	10			1
	2	10^-	*	—	10	10	9	10			1
	3	9^+	*	—	10	10	9	10	10	M	1
	4	9^+	*	—	10	10	9	10	10	M	1
104	1	10	*	10	10	10	9	10			1
	2	10	*	10	10	10	9	10			1
	3	—	*	10	10	10	9	10	10	VL	1
	4	—	*	10	10	10	9	10	10	VL	1
131	1	10	*	10	10	10	9	10			1
	2	10	*	10	10	10	9	10			1
	3	10	*	10	10	10	9	10	10	VL	1
	4	10	*	10	10	10	9	10	10	VL	1

NOTE: Meaning of abbreviations –

VL = very light   M = medium   F = few   O/L = light rusting in scribe   L/S = light tuberculation in scrib
S = slight   H = heavy   D = dense   O/M = medium rusting in scribe   M/S = medium tuberculation in s

Table 10. Continued

[Refer to Remarks column for each asterisked item.]

Rating for Following Properties –								Remarks
Rusting		Tuberculation	Rusting Scribe	Blistering	Undercutting	Blistering Scribe	Dry Film Thickness (mils)	
Type I	Type II							
System 44 (continued)								
9	10			10	10			Rust stain from top edge and hole.
9	10			10	10			Rust stain from top edge and hole.
9	10	10	VL	10	10	9		Rust stain from top edge and scribe.
9	10	10	VL	10	10	9		Rust stain from top edge and scribe.
9	10			10	10			Rust stain from top edge and hole.
9	10			10	10			Rust stain from top edge and hole.
9	10	10	VL	10	10	8		Rust stain from top edge and scribe.
9	10	10	VL	10	10	8		Rust stain from top edge and scribe.
9	10			10	10			Rust stain from top edge and hole.
9	10			10	10			Rust stain from top edge and hole.
9	10	10	VL	10	10	8		Rust stain from top edge and scribe.
9	10	10	VL	10	10	8		Rust stain from top edge and scribe.
System 45								
10	10			10	10		13	
10	10			10	10		13	
10	10	10	8	10	10	10	12	
10	10	10	6	10	10	10	13	
10	10			10	10			
10	10			10	10			
10	10	10	1/VL	10	10	—		Rust stain from scribe.
10	10	10	1/VL	10	10	—		Rust stain from scribe.
10	10			10	10			
10	10			10	10			
10	10	VL/S	L	10	10	4/F		
10	10	VL/S	L	10	10	4/F		
9	10			10	10			Rust stain from top edge and hole.
9	10			10	10			Rust stain from top edge and hole.
9	10	10	M	10	10	10		Rust stain from top edge and scribe.
9	10	10	M	10	10	10		Rust stain from top edge and scribe.
9	10			10	10			Rust stain from top edge and hole.
9	10			10	10			Rust stain from top edge and hole.
9	10	10	VL	10	10	9		Rust stain from top edge and scribe.
9	10	10	VL	10	10	9		Rust stain from top edge and scribe.
9	10			10	10			Rust stain from top edge and hole.
9	10			10	10			Rust stain from top edge and hole.
9	10	10	VL	10	10	8		Rust stain from top edge and scribe.
9	10	10	VL	10	10	8		Rust stain from top edge and scribe.

continued

t rusting in scribe   L/S = light tuberculation in scribe   H/S = heavy tuberculation in scribe
dium rusting in scribe   M/S = medium tuberculation in scribe

Table 10. Continued

[Refer to Remarks column for each asterisked item.]

Exposure (days)	Panel	General Protection	Discoloration	Chalking	Alligatoring, Checking, Cracking	Scaling, Flaking, Peeling	Rusting Type I	Rusting Type II	Tuberculation	Rusting Scribe	Blisteri
						System 45 (continued)					
180	1	10	*	10	10	10	9	10			10
	2	10	*	10	10	10	9	10			10
	3	10	*	10	10	10	9	10	10	VL	10
	4	10	*	10	10	10	9	10	10	VL	10
						System 46					
10	1	10	*	10	10	10	10	10			10
	2	10	*	10	10	10	10	10			10
	3	10	*	10	10	10	10	10	10	4	10
	4	10	*	10	10	10	10	10	10	2	10
27	1	10	—	—	10	10	10	10			10
	2	10	—	—	10	10	10	10			10
	3	10	*	—	10	10	10	10	VL-S	1/VL	10
	4	10	*	—	10	10	10	10	VL-S	1/VL	10
54	1	10	—	—	10	10	10	10			10
	2	10	—	—	10	10	10	10			10
	3	10^-	—	—	10	10	10	10	10	L	10
	4	10^-	—	—	10	10	10	10	10	L	10
86	1	9^+	*	—	10	10	9	10			10
	2	9^+	*	—	10	10	9	10			10
	3	9^+	*	—	10	10	9	10	10	L	10
	4	9^+	*	—	10	10	9	10	10	L	10
104	1	—	*	10	10	10	9	10			10
	2	—	*	10	10	10	9	10			10
	3	—	*	10	10	10	10	10	10	M	10
	4	—	*	10	10	10	10	10	10	M	10
131	1	10	*	10	10	10	9	10			10
	2	10	*	10	10	10	9	10			10
	3	10	*	10	10	10	9	10	10	M	10
	4	10	*	10	10	10	9	10	10	M	10
180	1	10	*	10	10	10	9	10			10
	2	10	*	10	10	10	9	10			10
	3	10	*	10	10	10	9	10	10	M	10
	4	10	*	10	10	10	9	10	10	M	10

NOTE: Meaning of abbreviations –

VL = very light; S = slight; M = medium; H = heavy; F = few; D = dense; O/L = light rusting in scribe; O/M = medium rusting in scribe; L/S = light tuberculation in scribe; M/S = medium tuberculation in scrib

Table 10. Continued

marks column for each asterisked item.]

wing Properties –							Remarks
ng Type II	Tuberculation	Rusting Scribe	Blistering	Undercutting	Blistering Scribe	Dry Film Thickness (mils)	
System 45 (continued)							
10			10	10			Rust stain from top edge and hole.
10			10	10			Rust stain from top edge and hole.
10	10	VL	10	10	8		Rust stain from top edge and scribe.
10	10	VL	10	10	8		Rust stain from top edge and scribe.
System 46							
10			10	10		14	Very light rust stain from hole in top.
10			10	10		11	Very light rust stain from hole in top.
10	10	4	10	10	10	14	Light rust stain from scribe.
10	10	2	10	10	10	14	Light rust stain from scribe.
10			10	10			
10			10	10			
10	VL-S	1/VL	10	10	—		Light rust stain from scribe.
10	VL-S	1/VL	10	10	—		Rust stain from top edge and scribe.
10			10	10			
10			10	10			
10	10	L	10	10	10		
10	10	L	10	10	10		
10			10	10			Rust stain from top edge and hole.
10			10	10			Rust stain from top edge and hole.
10	10	L	10	10	8/F		Rust stain from top edge and scribe.
10	10	L	10	10	8/F		Rust stain from top edge and scribe.
10			10	10			Rust stain from top edge and hole.
10			10	10			Rust stain from top edge and hole.
10	10	M	10	10	8		Rust stain from top edge and scribe.
10	10	M	10	10	8		Rust stain from top edge and scribe.
10			10	10			Rust stain from top edge and hole.
10			10	10			Rust stain from top edge and hole.
10	10	M	10	10	8		Rust stain from top edge and scribe.
10	10	M	10	10	8		Rust stain from top edge and scribe.
10			10	10			Rust stain from top edge and hole.
10			10	10			Rust stain from top edge and hole.
10	10	M	10	10	8		Rust stain from top edge and scribe.
10	10	M	10	10	8		Rust stain from top edge and scribe.

continued

be L/S = light tuberculation in scribe H/S = heavy tuberculation in scribe
scribe M/S = medium tuberculation in scribe

Table 10. Continued

[Refer to Remarks column for each asterisked iten

Exposure (days)	Rating for Following Properties –								
	Panel	General Protection	Discoloration	Chalking	Alligatoring, Checking, Cracking	Scaling, Flaking, Peeling	Rusting Type I	Rusting Type II	Tuberculation	Rustin Scribe
System 47										
10	1	10	—	10	10	10	10	10		
	2	10	—	10	10	10	10	10		
	3	10	*	10	10	10	10	10	10	4
	4	10	*	10	10	10	10	10	10	1
27	1	10	—	—	10	10	10	10		
	2	10	—	—	10	10	10	10		
	3	10	—	—	10	10	—	10	—	—
	4	10	—	—	10	10	—	10	—	—
54	1	10^-	—	—	10	10	10^-*	10		
	2	10^-	—	—	10	10	10*	10		
	3	10^-	—	—	10	10	10	10	10	L
	4	10^-	—	—	10	10	10	10	10	L
86	1	10^-	*	—	10	10	10	10		
	2	10^-	*	—	10	10	10	10		
	3	9	*	—	10	10	9	10	10	L
	4	9^+	*	—	10	10	8	10	10	L
104	1	10	*	10	10	10	9	10		
	2	10	*	10	10	10	9	10		
	3	10	*	10	10	10	9	10	10	V/L
	4	10	*	10	10	10	9	10	10	V/L
131	1	10	*	10	10	10	9	10		
	2	10	*	10	10	10	9	10		
	3	10	*	10	10	10	8	10	10	V/L
	4	10	*	10	10	10	8	10	10	V/L
180	1	10	*	10	10	10	9	10		
	2	10	*	10	10	10	9	10		
	3	10	*	10	10	10	8	10	10	V/L
	4	10	*	10	10	10	8	10	10	V/L

NOTE: Meaning of abbreviations –

VL = very light
S = slight
M = medium
H = heavy
F = few
D = dense
O/L = light rusting in scribe
O/M = medium rusting in scribe
L/S = light tuberculati
M/S = medium tubercu

Table 10. Continued

[Refer to Remarks column for each asterisked item.]

Rating for Following Properties –									Remarks
Scaling, Flaking, Peeling	Rusting		Tuberculation	Rusting Scribe	Blistering	Undercutting	Blistering Scribe	Dry Film Thickness (mils)	
	Type I	Type II							
System 47									
10	10	10			10	10		15	
10	10	10			10	10		16	
10	10	10	10	4	10	10	10	17	Light rust stain from scribe.
10	10	10	10	1	10	10	10	17	Light rust stain from scribe.
10	10	10			10	10			
10	10	10			10	10			
10	—	10	—	—	—	10	—		
10	—	10	—	—	—	10	—		
10	10^{-}*	10			10	10			Top edge.
10	10*	10			10	10			Top edge.
10	10	10	10	L	10	10	10		
10	10	10	10	L	10	10	10		
10	10	10			10	10			Rust stain from top edge and hole.
10	10	10			10	10			Rust stain from top edge and hole.
10	9	10	10	L	10	10	2/F		Rust stain from top edge and scribe.
10	8	10	10	L	10	10	10		Rust stain from top edge and scribe.
10	9	10			10	10			Rust stain from top edge and hole.
10	9	10			10	10			Rust stain from top edge and hole.
10	9	10	10	V/L	9	10	9		Rust stain from top edge and scribe.
10	9	10	10	V/L	10	10	10		Rust stain from top edge and scribe.
10	9	10			10	10			Rust stain from top edge and hole.
10	9	10			10	10			Rust stain from top edge and hole.
10	8	10	10	V/L	9	10	9		Rust stain from top edge and scribe.
10	8	10	10	V/L	10	10	10		Rust stain from top edge and scribe.
10	9	10			10	10			Rust stain from top edge and hole.
10	9	10			10	10			Rust stain from top edge and hole.
10	8	10	10	V/L	9	10	9		Rust stain from top edge and scribe.
10	8	10	10	V/L	10	10	10		Rust stain from top edge and scribe.

O/L = light rusting in scribe
O/M = medium rusting in scribe
L/S = light tuberculation in scribe
M/S = medium tuberculation in scribe
H/S = heavy tuberculation in scribe

Table 11. Panel Rating of Coating Systems 48 Through 53 After Salt Sp

[Refer to Remarks column for explanations of items marked with symbols

Exposure (days)	Panel	General Protection	Discoloration	Chalking	Cracking	Flaking	Rusting		Tuberculation Scribe	Rusting Scribe	Blistering	Underc
							Type I	Type II				
System 48												
Start	1	10	—	—	10	10	10	10	—	—	10	1
	2	10	—	—	10	10	10	10	—	—	10	1
	3	10	—	—	10	10	10	10	10	10	10	1
	4	10	—	—	10	10	10	10	10	10	10	1
31	1	9^+	—	—	10	10	9^+	9^+	—	—	8/F	*
	2	9^+	—	—	10	10	9^+	9^+	—	—	8/F	[illegible]
	3	9	—	—	10	10	9	9	8	M	8/F	[illegible]
	4	9	—	—	10	10	9	9	8	M	8/F	*
45	1	9	—	—	—	—	9	10	—	—	8/F*	1
	2	9^-	—	—	—	—	9^{-*}	8^+	—	—	8/F*	1
	3	9^-	—	—	—	—	9^{-*}	8	M	H	8/F*	1
	4	8^+	—	—	—	—	8^{+*}	9^{-*}	M-H	H	8/F*	L
60	1	9^-	—	—	10	10	9	9^-	—	—	8/F*	VL
	2	8	—	—	10	10	9	8	—	—	8/M*	VL
	3	8	—	—	10	10	8^{+*}	8^{+*}	M/S	H	8/F*	M/
	4	8	—	—	10	10	8^*	8^{-*}	H/S	H	8/F*	H/
74	1	9^-	—	—	10	10	$9^{*,\dagger}$	9^{-*}	—	—	6/F	1
	2	8	—	—	10	10	9	8^*	—	—	8/M	1
	3	8	—	—	10	10	8^+	8	M/S	H	8/F	M/
	4	8^-	—	—	10	10	8^{+*}	8^{-*}	M/S	H	8/M-D*	M/
125	1	8	—	—	10	10	9	8	—	—	8/M	1
	2	8^-	—	—	10	10	9	8	—	—	8/D	1
	3	7	—	—	10	10	8	8^-	H/S	H	8/D	M/
	4	8^-	—	—	10	10	8	8^-	H/S	H	8/D	M/
155	1	8^-	—	—	10	10	9^-	8^-	—	—	8/M	1
	2	7	—	—	9	10	8	7	—	—	4/D	1
	3	[illegible]	—	—	9	10	8^-	7	H/S	H	4/D	—
	4	[illegible]	—	—	9^-	10	8^-	6	H/S	H	4/D	—
System 49												
Start	1	10	—	—	10	10	10	10	—	—	10	10
	2	10	—	—	10	10	10	10	—	—	10	10
	3	10	—	—	10	10	10	10	10	10	10	10
	4	10	—	—	10	10	10	10	10	10	10	10
31	1	10	—	—	10	10	10	10	—	—	10	—
	2	10^-	—	—	10	10	10^*	10	—	—	10	—
	3	9^+	—	—	10	10	9^*	10	8	M	10	10
	4	9^+	—	—	10	10	10	10	8	M	10	10

NOTE: Meaning of abbreviations –

VL = very light M = medium F = few O/L = light rusting in scribe L/S = light tubercul

S = slight H = heavy D = dense O/M = medium rusting in scribe M/S = medium tube

ıting Systems 48 Through 53 After Salt Spray Exposure

for explanations of items marked with symbols * and †.]

ıberculation Scribe	Rusting Scribe	Blistering	Undercutting	Blistering Scribe	Remarks
System 48					
—	—	10	10	—	Coating thickness, 5 mils.
—	—	10	10	—	Coating thickness, 4 mils.
10	10	10	10	10	Coating thickness, 4½ mils.
10	10	10	10	10	Coating thickness, 4 mils.
—	—	8/F	*	—	*Upper left corner.
—	—	8/F	*	—	*Top edge.
8	M	8/F		10	
8	M	8/F	*	10	*Edge.
—	—	8/F*	10		*Top and near edge.
—	—	8/F*	10		Rusting Type II at top and one edge; *edge.
M	H	8/F*	10	8/M	Rusting on scribe becoming heavy; *edge.
M-H	H	8/F*	L	8/F	Coating being undercut and coating flaking off; *edge.
—	—	8/F*	VL	—	*Top edge.
—	—	8/M*	VL	—	*Top edge, lower corner and few in center.
M/S	H	8/F*	M/S	8/D	*Edge.
H/S	H	8/F*	H/S	8/D	*Edge.
—	—	6/F	10	—	*Edge; †pinpoint rust.
—	—	8/M	10	—	*Corners.
M/S	H	8/F	M/S	6/M	
M/S	H	8/M-D*	M/S	8/MD	*Edge.
—	—	8/M	10	—	
—	—	8/D	10	—	
H/S	H	8/D	M/S	8/D	Backside rated 8^+.
H/S	H	8/D	M/S	8/D	Backside rated 8^+.
—	—	8/M	10	—	
—	—	4/D	10	—	
H/S	H	4/D	—	VD*	*Light flaking, heavy blistering and Type II rusting.
H/S	H	4/D	—	*	*Light flaking, heavy blistering and Type II rusting.
System 49					
—	—	10	10	—	Coating thickness, 6 mils.
—	—	10	10	—	Coating thickness, 6 mils.
10	10	10	10	10	Coating thickness, 6 mils.
10	10	10	10	10	Coating thickness, 6 mils.
—	—	10	—	—	
—	—	10	—	—	*Pinpoint rusting, 3-4 spots.
8	M	10	10	10	*Top right corner.
8	M	10	10	10	

continued

in scribe L/S = light tuberculation in scribe H/S = heavy tuberculation in scribe
ing in scribe M/S = medium tuberculation in scribe

Table 11. Continued

[Refer to Remarks column for explanations of items marked with symbols * and

Exposure (days)	Panel	General Protection	Discoloration	Chalking	Cracking	Flaking	Rusting		Tuberculation Scribe	Rusting Scribe	Blistering	Undercutting
							Type I	Type II				
System 49 (continued)												
45	1	10^-	—	—	—	—	10^-	10	—	—	10	10
	2	10^-	—	—	—	—	10^-	10	—	—	10	10
	3	10^-	—	—	—	—	9	10	M	M	10	10
	4	10^-	—	—	—	—	9	10	M	M	10	10
60	1	10^-	*	—	10	10	10^-	10	—	—	10	10
	2	10^-	*	—	10	10	$10^{-\dagger}$	10	—	—	10	10
	3	10^-	—	—	10	10	10^{-*}	10	M/S	M	10	VL
	4	10^-	—	—	10	10	10^{-*}	10	M/S	M	10	VL
74	1	9^+	*	—	10	10	$9^{+\dagger}$	10	—	—	10	10
	2	9	*	—	10	10	$9^{\dagger}$	10	—	—	10	10
	3	9^+	*	—	10	10	$9^{+\dagger}$	10	10	H	10	L/S
	4	9^+	*	—	10	10	$9^{+\dagger}$	10	L/S	H	10	M/S
125	1	9^+	*	—	10	10	9^+	10	—	—	10	10
	2	9^+	*	—	10	10	9^+	10	—	—	10	10
	3	9	*	—	10	10	9	10	H/S	H	10	10
	4	9	*	—	10	10	9	10	H/S	H	10	10
155	1	9	*	—	10	10	9	10	—	—†	6/M-D	10
	2	8^+	—	—	10	10	8	10	—	—	6/D*	10
	3	8^+	—	—	10	10	9	10	H/S	H	6/F	M/S
	4	9^-	—	—	10	10	9	10	H/S	H	6/F	M/S
System 50												
Start	1	10	—	—	10	10	10	10	—	—	10	10
	2	10	—	—	10	10	10	10	—	—	10	10
	3	10	—	—	10	10	10	10	10	10	10	10
	4	10	—	—	10	10	10	10	10	10	10	10
31	1	9^+	—	—	10	10	10^-	9^+	—	—	8/F*	—
	2	10^-	—	—	10	10	10^{-*}	10	—	—	10	—
	3	9^+	—	—	10	10	10	10	10	M	10	10
	4	9^+	—	—	10	10	9^+	10	9	M	10	10
45	1	10^-	—	—	—	—	10	9^+	—	—	8/F*	L
	2	10	—	—	—	—	10	10	—	—	10	10
	3	9^+	—	—	—	—	10	10	10	L	10	10
	4	9^+	—	—	—	—	10	10	10	M	10	10
60	1	9	—	—	10	10	9^+	9	—	—	8/F	VL*
	2	10	—	—	10	10	10	10	—	—	—	10
	3	9	—	—	10	10	10	10	10	VL	10	10
	4	9^+	—	—	10	10	10	10	10	L	10	10

NOTE: Meaning of abbreviations –

VL = very light M = medium F = few O/L = light rusting in scribe L/S = light tuberculation ir
S = slight H = heavy D = dense O/M = medium rusting in scribe M/S = medium tuberculatio

Table 11. Continued

...s column for explanations of items marked with symbols * and †.]

...pe II	Tuberculation Scribe	Rusting Scribe	Blistering	Undercutting	Blistering Scribe	Remarks
	System 49 (continued)					
	—	—	10	10	—	Light rust stain from top of panel.
	—	—	10	10	—	Some pinpoint rust; more rust stain than B-1.
	M	M	10	10	10	Other than at scribe, only light rust stain from pinpoint rust at top edge.
	M	M	10	10	10	Other than at scribe, only light rust stain from pinpoint rust at top edge.
	—	—	10	10	—	*Rust stain.
	—	—	10	10	—	*Rust stain; †pinpoint rusting on edge.
	M/S	M	10	VL	10	Very light rusting on edge; *edge.
	M/S	M	10	VL	10	Very light rusting on edge; *edge.
	—	—	10	10	—	*Rust stain; †edge.
	—	—	10	10	—	*Rust stain; †edge.
	10	H	10	L/S	10	*Rust stain; †edge.
	L/S	H	10	M/S	10	*Rust stain; †edge.
	—	—	10	10	—	*Rust stain.
	—	—	10	10	—	*Rust stain.
	H/S	H	10	10	—	*Rust stain.
	H/S	H	10	10	—	*Rust stain.
	—	—†	6/M-D	10	—	*Rust stain; †more blistering backside than front.
	—	—	6/D*	10	—	*Mostly on front.
	H/S	H	6/F	M/S	D	
	H/S	H	6/F	M/S	D	
	System 50					
	—	—	10	10	—	Coating thickness, 5 mils.
	—	—	10	10	—	Coating thickness, 6½ mils.
	10	10	10	10	10	Coating thickness, 4½ mils.
	10	10	10	10	10	Coating thickness, 5½ mils.
	—	—	8/F*	—	—	*Top right corner.
	—	—	10	—	—	*Light rust, bottom edge.
	10	M	10	10	8/F	Light rust, bottom edge.
	9	M	10	10	8/F	Light rust, bottom edge.
	—	—	8/F*	L	—	Blistering and Type I rust top corner of panel; *edge.
	—	—	10	10	—	
	10	L	10	10	8/F	Blisters at scribe filled with rust.
	10	M	10	10	8/F	Blisters at scribe filled with rust.
	—	—	8/F	VL*	—	*Top corner and edge.
	—	—	—	10	—	
	10	VL	10	10	4/M*	*Blisters cover whole area around scribe.
	10	L	10	10	8-6/M	Blisters cover whole area around scribes.

continued

...rusting in scribe L/S = light tuberculation in scribe H/S = heavy tuberculation in scribe
...ium rusting in scribe M/S = medium tuberculation in scribe

2

Table 11. Continued

[Refer to Remarks column for explanations of items marked with symbols * and †.]

Exposure (days)	Panel	General Protection	Discoloration	Chalking	Cracking	Flaking	Rusting		Tuberculation Scribe	Rusting Scribe	Blistering	Undercutting
							Type I	Type II				
System 50 (continued)												
74	1	9	—	—	10	10	9^+	9	—	—	2-8/M	10
	2	10^-	—	—	10	10	9^+	10	—	—	8/F*	10
	3	10^-	—	—	10	10	9^+	10	VL-S	L	8/M*	10
	4	9^+	—	—	10	10	9^+	10	VL-S	M	8/M*	L/S
125	1	9	—	—	10	10	9^+	10	—	—	6/M-D*	10
	2	9	—	—	10	10	9^+	10	—	—	6/M-D*	10
	3	9	—	—	10	10	9	9^-	VL-S	L	6/M*	—
	4	8^+	—	—	10	10	9	9^-	M/S	M	6-4/M*	—
155	1	8	—	—	10	10	9	8	—	—	8/D*,†	10
	2	8^+	—	—	10	10	9	8^+	—	—	4/M*	10
	3	8^+	—	—	10	10	8	8^-	L/S	M	6/M-D	10
	4	8	—	—	10	10	9^-	8	M/S	M	4/D	L/S
System 51												
Start	1	10	—	—	10	10	10	10	—	—	10	10
	2	10	—	—	10	10	10	10	—	—	10	10
	3	10	—	—	10	10	10	10	10	10	10	10
	4	10	—	—	10	10	10	10	10	10	10	10
31	1	9	—	—	10	10	9*	10^-	—	—	6/F†	—
	2	9	—	—	10	10	10^-	—	—	—	8/F*	—
	3	9	—	—	10	10	10	10^-	8	M	10	10
	4	9	—	—	10	10	10	10^-	8	M	8/F*	10
45	1	9^-	—	—	—	—	10	9^-	—	—	8/F	L
	2	9	—	—	—	—	9*	9	—	—	8/F	L
	3	8^+	—	—	—	—	9*	8^+	M	M	8/F	L
	4	8^+	—	—	—	—	9*	8^+	M	M	8/F	L
60	1	9^-	—	—	10	10	9^+	9	—	—	8-6*	10
	2	9	—	—	10	10	9	9^-	—	—	8/M*	10
	3	8^-	—	—	10	10	8^+	8^-	M/S	H	8/M	L/S
	4	8	—	—	10	10	8	8	M/S	H	8/F	L/S
74	1	8^+	—	—	10	10	9	9	—	—	8/M*	10
	2	8^+	—	—	10	10	9	9	—	—	8/M*	10
	3	8^-	—	—	10	10	8	8^-	M/S	H	8/D	L/S
	4	8^+	—	—	10	10	8^+	8	L/S	H	8/M*	L/S
125	1	8	—	—	10	10	9	8	—	—	4/M	*
	2	7^+	—	—	10	10	9	8^-	—	—	6/D	—
	3	7^-	—	—	10	10	9	7	M/S	H	8/D	—
	4	8	—	—	10	10	8^+	8	H/S	H	6/M-D	—
155	1	8^-	—	—	10	10	8^+	8^-	—	—	4/M	10
	2	7	—	—	10	10	8	7	—	—	4/D	10
	3	6	—	—	10	10	8	6	M/S	H	6/D	L/S
	4	8^-	—	—	10	10	8	8^-	H/S	H	6/M-D	L/S

NOTE: Meaning of abbreviations –

VL = very light
S = slight
M = medium
H = heavy
F = few
D = dense
O/L = light rusting in scribe
O/M = medium rusting in scribe
L/S = light tuberculation in s
M/S = medium tuberculation

Table 11. Continued

for explanations of items marked with symbols * and †.]

uberculation Scribe	Rusting Scribe	Blistering	Undercutting	Blistering Scribe	Remarks
System 50 (continued)					
—	—	2-8/M	10	—	Blistering two top corners only.
—	—	8/F*	10	—	*Top, close to edge.
VL-S	L	8/M*	10	4/D	*Top, close to edge.
VL-S	M	8/M*	L/S	4-8/D	*Top, close to edge.
—	—	6/M-D*	10	—	*Top edges.
—	—	6/M-D*	10	—	*Top edges.
VL-S	L	6/M*	—	—	*Top and bottom near edge and scribed area.
M/S	M	6-4/M*	—	—	*Medium blisters, top and bottom; H/D, scribed area.
—	—	8/D*,†	10	—	*Blisters confined mostly to top and bottom of panel; †edge.
—	—	4/M*	10	—	*Blisters confined mostly to top and bottom of panel.
L/S	M	6/M-D	10	6/D	
M/S	M	4/D	L/S	6/D	
System 51					
—	—	10	10	—	Coating thickness, 5½ mils.
—	—	10	10	—	Coating thickness, 5 mils.
10	10	10	10	10	Coating thickness, 4 mils.
10	10	10	10	10	Coating thickness, 4 mils.
—	—	6/F†	—	—	*Edge; †upper right corner.
—	—	8/F*	—	—	*Edge.
8	M	10	10	10	
8	M	8/F*	10	10	*Edge.
—	—	8/F	L	—	Type II rusting, upper corner; coating flaked off.
—	—	8/F	L	—	Type II rusting, upper corner; coating flaked off; *edge.
M	M	8/F	L	8/M	*Edge.
M	M	8/F	L	8/M	*Edge.
—	—	8-6*	10	—	Blisters and Type II rusting, top corner; *edge.
—	—	8/M*	10	—	Blisters and Type II rusting, top corner; *edge.
M/S	H	8/M	L/S	8/MD	Blistering extends out from scribe to center of panel.
M/S	H	8/F	L/S	8/F	
—	—	8/M*	10	—	*Edge.
—	—	8/M*	10	—	*Edge.
M/S	H	8/D	L/S	8/D	
L/S	H	8/M*	L/S	8/M	*Edge
—	—	4/M	*	—	*Top half backside blisters and rusting.
—	—	6/D	—	—	Backside, fair.
M/S	H	8/D	—	—	Backside, 8.
H/S	H	6/M-D	—	—	Backside, 8.
—	—	4/M	10	—	
—	—	4/D	10	—	
M/S	H	6/D	L/S	*	*Blister broken, Type II rusting.
H/S	H	6/M-D	L/S	*	*Blister broken, Type II rusting.

continued

n scribe L/S = light tuberculation in scribe H/S = heavy tuberculation in scribe
ng in scribe M/S = medium tuberculation in scribe

2

Table 11. Continued

[Refer to Remarks column for explanations of items marke

Exposure (days)	Panel	General Protection	Discoloration	Chalking	Cracking	Flaking	Rusting Type I	Rusting Type II	Tuberculation Scribe	Rusting Scribe	Blist
									System 52		
Start	1	10	—	—	10	10	10	10	—	—	1
	2	10	—	—	10	10	10	10	—	—	1
	3	10	—	—	10	10	10	10	10	10	1
	4	10	—	—	10	10	10	10	10	10	1
31	1	9^+	—	—	10	10	9*	10	—	—	1
	2	9	—	—	10	10	9*	10	—	—	1
	3	9^-	—	—	10	10	9*	10^-	7	M	1
	4	9	—	—	10	10	9*	10^-	8	L	1
45	1	9	—	—	—	—	8^{+*}	8^{+*}	—	—	8.
	2	9	—	—	—	—	9*	9*	—	—	1
	3	9^-	—	—	—	—	9*	8^{+*}	M	M	8.
	4	9^-	—	—	—	—	8^{+*}	8^{+*}	M	H	8.
60	1	9	—	—	10	10	8^{+*}	8^{+*}	—	—	8/
	2	9	—	—	10	10	8*	8*	—	—	6.
	3	9	—	—	10	10	8	8^+	L/S	M	8/
	4	9^-	—	—	10	10	9	8^-	L/S	M	8.
74	1	9	—	—	10	10	9^+	9	—	—	8/
	2	9^-	—	—	10	10	8^+	9^-	—	—	8/
	3	9	—	—	10	10	9	9	M/S	H	6/
	4	8	—	—	10	10	9	8^+	M/S	M	8/
125	1	8^+	—	—	10	10	9	8	—	—	8/
	2	8^+	—	—	10	10	9	8	—	—	6/M
	3	8^-	—	—	10	10	9	8^-	H/S	H	6/
	4	8	—	—	10	10	9	8^-	M/S	H	6-4
155	1	8^-	—	—	10	10	9	8^-	—	—	6/
	2	8^-	—	—	10	10	9	8^-	—	—	8/
	3	8^-	—	—	10	10	8	8^-	L/S	H	8/
	4	8^-	—	—	10	10	8	8^-	L/S	H	6/
									System 53		
Start	1	10	—	—	10	10	10	10	—	—	1
	2	10	—	—	10	10	10	10	—	—	1
	3	10	—	—	10	10	10	10	10	10	1
	4	10	—	—	10	10	10	10	10	10	1
31	1	8	—	—	10	10	8	10	—	—	–
	2	8	—	—	10	10	8	10	—	—	–
	3	8	—	—	10	10	7*	—	7	H	–
	4	8	—	—	10	10	7*	—	7	H	–

NOTE: Meaning of abbreviations –

VL = very light
S = slight
M = medium
H = heavy
O/L = light rusting in scribe
O/M = medium rusting in scribe
L/S = light tuberculation in sc
M/S = medium tuberculation i

Table 11. Continued

[Refer to Remarks column for explanations of items marked with symbols * and †.]

Cracking	Flaking	Rusting Type I	Rusting Type II	Tuberculation Scribe	Rusting Scribe	Blistering	Undercutting	Blistering Scribe	Remarks
				System 52					
10	10	10	10	—	—	10	10	—	Coating thickness, 4½ mils.
10	10	10	10	—	—	10	10	—	Coating thickness, 5 mils.
10	10	10	10	10	10	10	10	10	Coating thickness, 4 mils.
10	10	10	10	10	10	10	10	10	Coating thickness, 5 mils.
10	10	9*	10	—	—	10	10	—	*Edge.
10	10	9*	10	—	—	10	10	—	*Edge.
10	10	9*	10^-	7	M	10	10	10	*Edge.
10	10	9*	10^-	8	L	10	10	10	*Edge.
—	—	8^{+}*	8^{+}*	—	—	8/F	L	—	Type II rusting, top and bottom edges.
—	—	9*	9*	—	—	10	10	—	*Edge.
—	—	9*	8^{+}*	M	M	8/F	L	8/F	*Edge.
—	—	8^{+}*	8^{+}*	M	H	8/F	L	8/F	*Edge.
10	10	8^{+}*	8^{+}*	—	—	8/M	10	—	Blisters, top edge and bottom only; *edge.
10	10	8*	8*	—	—	6/F	10	—	*Edge.
10	10	8	8^+	L/S	M	8/F*	L/S	8/F	*Edge.
10	10	9	8^-	L/S	M	8/F	L/S	8/F	
10	10	9^+	9	—	—	8/M*	10	—	*Top and bottom edges.
10	10	8^+	9^-	—	—	8/M*	10	—	*Edge.
10	10	9	9	M/S	H	6/F*	M/S	8/M	*Edge.
10	10	9	8^+	M/S	M	8/M	L/S	8/F	
10	10	9	8	—	—	8/M*	—	—	*Top and bottom; backside, 9.
10	10	9	8	—	—	6/M-D*	—	—	*Edges; backside, 8^-.
10	10	9	8^-	H/S	H	6/M-D	—	—	
10	10	9	8^-	M/S	H	6-4/M	—	—	Backside, 9^-.
10	10	9	8^-	—	—	6/D*	10	—	One surface, rate 9; *mostly top and bottom.
10	10	9	8^-	—	—	8/M-D	10	—	Worse on one side than other.
10	10	8	8^-	L/S	H	8/D	L/S	*	*Type II rusting.
10	10	8	8^-	L/S	H	6/D	L/S	*	*Type II rusting.
				System 53					
10	10	10	10	—	—	10	10	—	Coating thickness, 4 mils.
10	10	10	10	—	—	10	10	—	Coating thickness, 4½ mils.
10	10	10	10	10	10	10	10	10	Coating thickness, 3½ mils.
10	10	10	10	10	10	10	10	10	Coating thickness, 3 mils.
10	10	8	10	—	—	—	—	—	Most of surface covered with pinpoint rust and rust stain.
10	10	8	10	—	—	—	—	—	Most of surface covered with pinpoint rust and rust stain.
10	10	7*	—	7	H	—	—	—	Most of surface covered with pinpoint rust and rust stain; *edge.
10	10	7*	—	7	H	—	—	—	Most of surface covered with pinpoint rust and rust stain; *edge.

continu

)/L = light rusting in scribe
/M = medium rusting in scribe
L/S = light tuberculation in scribe
M/S = medium tuberculation in scribe
H/S = heavy tuberculation in scribe

Table 11. Continued

[Refer to Remarks column for explanations of items marked with s

Exposure (days)	Panel	General Protection	Discoloration	Chalking	Cracking	Flaking	Rusting Type I	Rusting Type II	Tuberculation Scribe	Rusting Scribe	Blistering
System 53 (continued)											
45	1	8⁻	—	—	—	—	8⁻	8	—	—	10
	2	8⁻	—	—	—	—	8⁻	8	—	—	10
	3	8⁻	—	—	—	—	8⁻	8	M	H	10
	4	8⁻	—	—	—	—	8⁻	8	M	H	10
60	1	8⁻	—	—	10	10	8⁻	8	—	—	6/D
	2	8⁻	—	—	10	10	8⁻	8	—	—	6/D
	3	8⁻	—	—	10	10	8⁻	8	M/S	H	6/D
	4	8⁻	—	—	10	10	8⁻	8	L	M	6/D
74	1	7	—	—	10	10	8	7	—	—	2/D
	2	7	—	—	10	10	8	7	—	—	2/D
	3	7	—	—	10	10	7	7	H/S	H	2/D
	4	7	—	—	10	10	7	7	H/S	H	2/D
125	1	—	—	—	—	—	—	—	—	—	—
	2	—	—	—	—	—	—	—	—	—	—
	3	—	—	—	—	—	—	—	—	—	—
	4	—	—	—	—	—	—	—	—	—	—
155	1	—	—	—	—	—	—	—	—	—	—
	2	—	—	—	—	—	—	—	—	—	—
	3	—	—	—	—	—	—	—	—	—	—
	4	—	—	—	—	—	—	—	—	—	—

NOTE· Meaning of abbreviations –

VL = very light M = medium F = few O/L = light rusting in scribe L/S = light

S = slight H = heavy D = dense O/M = medium rusting in scribe M/S = mediu

Table 11. Continued

[Refer to Remarks column for explanations of items marked with symbols * and †.]								
Rusting		Tuberculation Scribe	Rusting Scribe	Blistering	Undercutting	Blistering Scribe	Remarks
Type I	Type II						
System 53 (continued)							
8^-	8	—	—	10	10	—	
8^-	8	—	—	10	10	—	
8^-	8	M	H	10	10	—	
8^-	8	M	H	10	10	—	
8^-	8	—	—	6/D	10	—	Blistering entire surface, unbroken.
8^-	8	—	—	6/D	10	—	Blistering entire surface, unbroken.
8^-	8	M/S	H	6/D	L/S	6/D	Blistering entire surface, unbroken.
8^-	8	L	M	6/D	L/S	6/D	Blistering entire surface, unbroken.
8	7	—	—	2/D	10	—	
8	7	—	—	2/D	10	—	
7	7	H/S	H	2/D	M/S	2/D	
7	7	H/S	H	2/D	M/S	2/D	
—	—	—	—	—	—	—	
—	—	—	—	—	—	—	
—	—	—	—	—	—	—	
—	—	—	—	—	—	—	
—	—	—	—	—	—	—	
—	—	—	—	—	—	—	
—	—	—	—	—	—	—	
—	—	—	—	—	—	—	

O/L = light rusting in scribe
O/M = medium rusting in scribe
L/S = light tuberculation in scribe
M/S = medium tuberculation in scribe
H/S = heavy tuberculation in scribe

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Appendix A

ANALYSIS OF TEST COATINGS

System No.	Part of System	Paint Component	Condition in Container	Viscosity (KU)	Weight Per Gallon (lb)	Total Solids (% by weight)	Water (% by weight)	Pigment (% by weight)
1	Primer	Epoxy Resin	Separated but easily mixed	65	12.5	56.1	40	50.2
		Curing Agent[b]	Homogeneous	—	—	66.2	—	—
	Intermediate Coat	Epoxy Resin	Separated but easily mixed	97	13.9	68.4	32[a]	49.2[c]
		Curing Agent[b]	Homogeneous	—	—	66.2	—	—
	Topcoat	Epoxy Resin	Separated but easily mixed	68	11.8	54.3	35	36.1[c]
		Curing Agent	Homogeneous	85	8.4	35.7	—	—
2	Primer	Epoxy Resin	Separated but easily mixed	67	14.4	69.3	27[a]	50.8[c]
		Curing Agent[b]	Homogeneous	—	—	70.8	—	—
	Topcoat	Epoxy Resin	Separated but easily mixed	55	11.7	51.7	47[a]	35.9[c]
		Curing Agent[b]	Homogeneous	—	—	34.5	—	—
3	Primer	Epoxy Resin	Homogeneous	106	12.6	78.1	25	45.6[c]
		Curing Agent	Homogeneous	106	11.9	68.4	21	45.3[c]
	Topcoat	Epoxy Resin	Separated but easily mixed	76	11.9	66.2	22	37.9[c]
		Curing Agent	Separated but easily mixed	115	12.0	67.3	30	43.8[c]
4	Universal Coat	Epoxy Resin	Separated but easily mixed	Too thick to measure	10.5	88.3	—	36.2
		Curing Agent	Separated but easily mixed	92	11.4	84.3	—	37.5
5	Primer	Epoxy Resin	Homogeneous	56	8.8	41.8	—	26.9
		Curing Agent	Homogeneous	—	—	24.6	—	—
	Topcoat	Epoxy Resin	Homogeneous	112	11.4	71.7	—	21.5
		Curing Agent	Separated but easily mixed	—	—	74.8	—	—
6	Wash Primer	Resin Component	Homogeneous	76	7.7	25.8	—	16.2
	Primer	—	Homogeneous	68	11.2	71.0	—	50.0
	Topcoat	—	Homogeneous	70	8.7	58.2	—	23.4

[a] Determined by azeotropic distillation with benzene.

[b] Curing agents of water emulsion epoxy were thin, water-free, and unpigmented.

[c] Ash determination made instead of pigment determination because of difficulties in separating pigment.

Appendix B

SOURCES AND IDENTIFICATION OF EXPERIMENTAL MATERIALS

KEY TO SOURCES

Key	Source
A	Adhesive Engineering Co., 1411 Industrial Rd., San Carlos, CA 94070.
B	Advanced Coatings and Chemicals, 2213 No. Tyler Ave., So. El Monte, CA 91733.
C	Ameron Inc., 201 N. Berry St., Brea, CA 92621.
D	Ashland Chemicals, P.O. Box 2219, Columbus, OH 43216.
E	Carboline Co., 350 Hanley Industrial Ct., St. Louis, MO 63144.
F	Frazee Paint Co. (formerly C. H. Benton, Inc.), P.O. Box 2471, San Diego, CA 92112.
G	MIT Chemicals, Inc., P.O Box 1104, Rahway, NJ 07065.
H	Mobil Chemical Co., Box 250, Edison, NJ 08817.
I	Porter Coatings, 400 So. B St., Louisville, KY 40201.
J	Proline Paint Co., 2646 Main St., San Diego, CA 92113.
K	Terra Sphere Chemical, Inc., 1225 So. West Ave., Fresno, CA 93706.
L	Western Maritime Agency, Inc., 444 W. Ocean Blvd., Long Beach, CA 90802.
M	Western Reserve Laboratories, 1348 St. Clair Ave., Cleveland, OH 44100.
N	Wisconsin Protective Coating Corp., P.O. Box 243, Green Bay, WI 54305.

IDENTIFICATION OF EXPERIMENTAL MATERIALS

System No.	Primer Name	Source[a]	Topcoat Name	Source[a]
1	Van Chem Water-Epoxy Metal Primer Red 13-R-10 (plus Val Chem Emulsion-Epoxy Enamel Catalyst 91-T-1)	H	Van Chem Emulsion-Epoxy Enamel 91-F-34 Warm Gray (plus Val Chem Emulsion-Epoxy Catalyst 91-T-2)	H
			Val Chem Water-Epoxy Hi-Build 98-W-10 White Base (plus Water-Epoxy Hi-Build Curing Agent 98-T-1)[b]	H
2	Ameron No. 2074 Epoxy Emulsion Primer	C	Ameron No. 2075 Epoxy Emulsion Coating	C
3	Carboline X2191-145 Epoxy Polyamide Primer	E	Carboline X2191-145 Epoxy Polyamide Finish	E
4	Carbomastic No. 15 Epoxy	E	Carbomastic No. 15 Epoxy	E
5	Amercoat No. 64 Polyamine-Cured Epoxy Primer	C	Amercoat No. 66 Polyamide-Cured Epoxy	C
6	TT-P-645 Zinc-Chromate Alkyd Primer	F	TT-P-489 Alkyd Gloss Enamel	F
	Mil-P-15328 Wash Pre-treatment Primer[c]	F		
7	Carboline No. 188 Primer	E	Carboline No. 190 HB	E

continued

System No.	Primer Name	Source[a]	Topcoat Name	Source[a]
8	Rustcon 230	E	Carboline No. 190 HB	E
9	Carboline No. 188 Primer	E	Carboline No. 190 HB	E
10	Carboline No. 188 Primer	E	Mil-P-24441-152	J
11	Terra Sphere Chemical (TSC) Metal Barrier	K	Mil-P-24441-152	J
12	Mil-P-24441-150	J	Mil-P-24441-152	J
13	Carboline No. 188 Primer	E	Mil-P-24441-152	J
14	TSC Metal Barrier	K	Mil-P-24441-152	J
15	Mil-P-24441-150	J	Mil-P-24441-152	J
16	Carboline No. 188 Primer	E	Carboline No. 190 HB	E
17	TSC Metal Barrier	K	Carboline No. 190 HB	E
18	Mil-P-24441-150	J	Carboline No. 190 HB	E
19	Carboline No. 188	E	Carboline No. 190 HB	E
20	TSC Metal Barrier	K	Carboline No. 190 HB	E
21	Mil-P-24441-150	J	Carboline No. 190 HB	E
22	CEL Underwater Epoxy	B	Mil-P-24441-152	J
23	CEL Epoxy With Tin Compound	B,D,G	Mil-P-24441-152	J

continued

System No.	Primer Name	Source[a]	Topcoat Name	Source[a]
24	Ultraviolet-Cured Paint	N	Mil-P-24441-152	J
25	CEL Underwater Epoxy	B	Mil-P-24441-152	J
26	CEL Epoxy With Tin Compound	B,D,G	Mil-P-24441-152	J
27	Ultraviolet-Cured Paint	N	Mil-P-24441-152	J
28	CEL Underwater Epoxy	B	Carboline No. 190 HB	E
29	CEL Epoxy With Tin Compound	B,D,G	Carboline No. 190 HB	E
30	Ultraviolet-Cured Paint	N	Carboline No. 190 HB	E
31	CEL Underwater Epoxy	B	Carboline No. 190 HB	E
32	CEL Epoxy With Tin Compound	B,D,G	Carboline No. 190 HB	E
33	Ultraviolet-Cured Paint	N	Carboline No. 190 HB	E
34	Zinox	L	Mil-P-24441-152	J
35	Mobilzinc 2	H	Val Chem Hi-Build Chlorinated Rubber	H
36	Zinox	L	Carboline No. 190 HB	E
37	Zinc Lock No. 351	I	Porter 1660	I
38	Mobilzinc 2	H	Val Chem Hi-Build Chlorinated Rubber	H

continued

System No.	Primer Name	Source[a]	Topcoat Name	Source[a]
39	Zinc Lock No. 351	I	Porter 1660	I
40	Zinox	L	Mil-P-24441-152	J
41	Zinox	L	Carboline No. 190 HB	E
42	Ultraviolet-Cured Paint	N	—	
43	Ultraviolet-Cured Paint	N	—	
44	CEL Underwater Epoxy	B	—	
45	CEL Underwater Epoxy	B	—	
46	CEL Epoxy With Tin Compound	B,D,G	—	
47	CEL Epoxy With Tin Compound	B,D,G	—	
48	Ultraviolet-Cured Paint	N	Mil-E-46141	F
49	Ultraviolet-Cured Paint	N	Mil-P-24441-152	J
50	Ultraviolet-Cured Paint	N	TT-E-485	F
51	Ultraviolet-Cured Paint	N	Phenolic Silicone Alkyd Enamel	J
52	Ultraviolet-Cured Paint	N	TT-E-489	F
53	Ultraviolet-Cured Paint	N	—	

[a] See Key to Sources.

[b] This high-build coat was used only on the sandblasted steel panels.

[c] This wash primer was used only on the sandblasted panels of System 6 and the original coating system applied to the weathered panels.

Appendix C

RATINGS ON COATING SYSTEMS

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Table C-1. Ratings[a] of System Panels on Sandblasted

[Ratings according to following standards — Chalking: ASTM D659; Cracking: ASTM D661; Flaking: ASTM I

Time Exposed (yr)	General Protection	Discoloration	Chalking	Cracking	Flaking	Rusting Type I	Rusting Type II	Tuberculation	Scribe Rusting
System 1									
1/2	8^+; 8^+	8; 8	6; 6	10; 10	10; 10	7; 7	8; 8	10; 10	O/L; O/L
1	8; 8	8; 8	4; 4	10; 10	10; 10	7; 7	8; 8	9; 9	O/L; O/L
1-1/2	8^-; 8	7; 8	2; 4	10; 10	10; 10	7; 6	8; 7	9; 9	O/M; O/M
2	8^-; 8	6; 8	2; 2	10; 10	10; 10	6; 6	7; 7	8; 8	O/M; O/M
2-1/2	7; 7	5; 7	2; 2	10; 10	10; 10	5; 5	7; 6	6; 8	O/M; O/M
System 3									
1/2	8; 8	6; 6	6; 6	10; 10	10; 10	8; 7	9; 8	10; 10	O/MD; O/MD
1	7; 7	2; 2	6; 6	10; 10	10; 10	7; 7	8; 8	6; 10	O/D; O/D
System 4									
1/2	9; 9	9; 9	8; 8	10; 10	10; 10	10; 9	10; 9	10; 10	O/L; O/L
1	8^+; 8^+	9; 9	8; 8	10; 10	10; 10	10; 9	10; 9	9; 10	O/L; O/L
1-1/2	8^+; 8^+	9; 9	6; 8	10; 10	10; 10	10; 9	10; 9	9; 10	O/L; O/L
2	8; 8	9; 9	8; 8	10; 10	10; 10	10; 9	10; 9	8; 9	O/L; O/L
2-1/2	8; 8	9; 9	8; 8	10; 10	10; 10	10; 9	10; 9	8; 9	O/L; O/L
3	8^-; 8^-	8; 8	4; 6	10; 10	10; 10	10; 9	10; 9	7; 8	O/M; O/M
System 5									
1/2	8; 8	7; 7	8; 8	10; 10	10; 10	8; 8	9; 9	10; 10	O/M; O/L
1	7; 7	6; 6	8; 8	10; 10	10; 10	8; 8	9; 9	8; 6	O/D; O/M
System 6									
1/2	8; 8	8; 8	8; 8	10; 10	10; 10	8; 8	9; 9	10; 10	O/L; O/L
1	8; 8	8; 7	6; 6	10; 10	10; 10	8; 8	9; 9	10; 10	O/L; O/L
1-1/2	8; 8	8; 6	4; 4	10; 10	10; 10	8; 8	9; 9	10; 10	O/L; O/L
2	8; 8^-	7; 6	6; 8	10; 10	10; 10	8; 8	9; 9	10; 10	O/L; O/L
2-1/2	8^-; 8^-	6; 5	8; 8	10; 10	10; 10	8; 8	9; 9	8; 8	O/M; O/L
3	7; 6	6; 4	4; 6	10; 10	10; 10	7; 7	8; 7	8; 8	O/M; O/MD

[a] Rating numbers from high of 10 to low of 0, generally the percentage of unaffected area divided by 10 unless otherwise indicated.

[b] Rating discontinued after failure.

NOTE: Meaning of abbreviations –

- E = edge
- F = few
- S = slight
- M = medium
- H = heavy
- D = dense
- L = light
- V/L = very light
- L/S = light tuberculation in scribe
- M/S = medium tuberculation in scribe
- H/S = heavy tuberculation in scribe
- O/L = light rusting in scribe
- O/M = medium rusting in scribe

Table C-1. Ratings[a] of System Panels on Sandblasted Steel

king: ASTM D659; Cracking: ASTM D661; Flaking: ASTM D772; Rusting: ASTM D610; Blistering: ASTM D714.]

Rusting Type I	Rusting Type II	Tuberculation	Scribe Rusting	Blistering	Undercutting	Scribe Blistered	Comments
		System 1					
7;7	8;8	10;10	O/L;O/L	8/L;8/L	10;10	6/MD;6/M	Rust staining; edge rusting.
7;7	8;8	9;9	O/L;O/L	8/L;8/L	9;9	4/MD;6/M	Rust staining; edge rusting.
7;6	8;7	9;9	O/M;O/M	8/L;8/L	8^+;9	4/MD;4/M	Rust staining; edge rusting.
6;6	7;7	8;8	O/M;O/M	8/L;8/L	8;8	4/MD;4/M	Rust staining; edge rusting.
5;5	7;6	6;8	O/M;O/M	6/M;6/M	6;7	2/MD;2/M	Failed.[b]
		System 3					
8;7	9;8	10;10	O/MD;O/MD	10;9/L	10;9	2/D;2/D	Much rusting.
7;7	8;8	6;10	O/D;O/D	2/L;8/L	8;8	2/D;2/D	Failed.[b]
		System 4					
10;9	10;9	10;10	O/L;O/L	10;10	10;10	6/L;10	Damage on edge and scribe only.
10;9	10;9	9;10	O/L;O/L	10;10	10;10	6/M;8/L	
10;9	10;9	9;10	O/L;O/L	10;10	10;10	2/M;2/L	
10;9	10;9	8;9	O/L;O/L	10;2/L	9;9	2/M;2/L	
10;9	10;9	8;9	O/L;O/L	10;2/L	8;9	2/M;2/L	
10;9	10;9	7;8	O/M;O/M	10;2/L	7;8	2/MD;2/M	
		System 5					
8;8	9;9	10;10	O/M;O/L	10;10	10;9	2/M;2/M	
8;8	9;9	8;6	O/D;O/M	2/L;2/L	9;8	2/D;2/MD	Failed.[b]
		System 6					
8;8	9;9	10;10	O/L;O/L	10;10	10;10	8/M;8/M	Rusting on edge and scribe only.
8;8	9;9	10;10	O/L;O/L	10;10	10;10	8/M;8/M	
8;8	9;9	10;10	O/L;O/L	10;10	10;10	6/M;6/M	
8;8	9;9	10;10	O/L;O/L	8/L;8/L	9;9	6/M;6/MD	
8;8	9;9	8;8	O/M;O/L	8/L;8/L	8;8	4/M;4/MD	
7;7	8;7	8;8	O/M;O/MD	8/L;8/L	8;8	4/M;4/D	Failed.[b]

area divided by 10 unless otherwise indicated.

2

Table C-2. Ratings of System Panels on Weathered System I

[Ratings according to following standards — Chalking: ASTM D659; Cracking: ASTM D661; Flaking: ASTM D772, Rusting: ASTM

Time Exposed (yr)	General Protection	Discoloration	Chalking	Cracking	Flaking	Rusting Type I	Rusting Type II	Tuberculation	Scribe Rusting	Blistering	Und
System 1											
1/2	$8^+;9^-$	8;8	4;4	10;10	10;10	9;9	9;9	10;10	O/M;O/M	8/MD;8/L	
1	$8^+;8^+$	7;8	4;4	10;10	10;10	9;9	9;9	10;10	O/M;O/M	8/MD;8/M	
1-1/2	$8;8^+$	7;8	4;4	10;10	10;10	9;9	9;9	10;9	O/M;O/M	8/MD;8/M	
2	8;8	6;7	6;6	10;10	10;10	8;9	9;9	9;9	O/M;O/M	6/D;8/M	
2-1/2	8;8	6;7	4;4	10;10	10;10	8;8	8;8	8;8	O/M;O/MD	6/D;8/M	
3	$8^-;8$	6;7	6;4	10;10	10;10	8;8	8;8	8;8	O/D;O/D	4/D;6/MD	
System 3											
1/2	$9^+;9^+$	10;10	6;6	10;10	10;10	9;10	10;10	10;10	O/M;D	10;10	
1	9;9	9;8	6;6	10;10	10;10	9;9	10;10	9;9	O/M;D	10;10	
1-1/2	$9;9^-$	8;8	4;4	10;10	10;10	9;9	10;10	9;9	O/M;D	10;10	
2	$9;9^-$	8;7	4;4	10;10	10;10	9;9	10;10	9;9	O/D;D	8/L;8/L	
2-1/2	8;8	8;7	4;4	10;10	10;10	9;9	9;9	9;9	O/D;D	6/L;4/L	
3	$8^-;8^-$	6;6	6;6	10;10	10;10	9;9	9;9	8;8	O/D;D	2/L;2/L	
System 4											
1/2	$10;9^+$	10;10	6;6	10;10	10;10	10;10	10;10	10;10	O/L;O/L	10;10	
1	$9^+;9$	9;9	8;8	10;10	10;10	9;9	10;10	10;10	O/L;O/L	10;8/M	
1-1/2	$9^+;9$	9;8	6;4	10;10	10;10	9;9	10;9	10;10	O/M;O/M	10;8/M	
2	$9;9^-$	9;8	8;6	10;10	10;10	9;9	10;9	9;9	O/M;O/M	8/M;6/M	
2-1/2	$9;8^+$	9;8	8;8	10;10	10;10	9;8	10;8	9;9	O/M;O/M	8/M;6/M	
3	$8^+;8^+$	8;8	6;6	10;10	10;10	9;8	9;8	8;8	O/M;O/M	2/M;4/M	
System 5											
1/2	$9;9^+$	9;9	6;8	10;10	10;10	10;9	10;9	10;10	O/M;O/M	10;10	
1	$8^+;9^+$	9;9	8;6	10;10	10;10	10;9	10;9	9;10	O/D;O/M	8/MD;10	
1-1/2	$8^+;9$	9;9	4;8	10;10	10;10	10;9	10;9	9;10	O/D;O/M	8/MD;10	
2	$8;9^-$	9;9	6;8	10;10	10;10	9;9	10;9	9;9	O/D;O/D	8/MD;8/M	
2-1/2	$8;8^+$	8;9	6;8	10;10	10;10	9;9	10;9	9;9	O/D;O/D	8/MD;8/MD	
3	8;8	7;8	6;8	10;10	10;10	9;9	10;9	9;9	O/D;O/D	8/MD;8/D	
System 6											
1/2	$9^+;9^-$	9;9	6;6	10;10	10;10	10;9	10;10	10;10	O/M;O/M	10;8/D	
1	$9^-;9^-$	9;9	6;6	10;10	10;10	9;9	10;9	9;10	O/M;O/M	10;8/D	
1-1/2	$9^-;9^-$	9;9	4;4	10;10	10;10	9;9	10;9	9;10	O/M;O/D	10;8/D	
2	$9^-;8^+$	8;8	6;6	10;10	10;10	9;9	10;9	9;9	O/D;O/D	10;8/D	
2-1/2	$8^+;8$	7;6	6;4	10;10	10;10	9;9	10;9	9;9	O/D;O/D	10;6/D	
3	$8;8^-$	7;6	6;6	10;10	10;10	9;9	9;9	9;9	O/D;O/D	10;6/D	

NOTE: Meaning of abbreviations –

E = edge
F = few
S = slight
M = medium
H = heavy
D = dense
L = light
V/L = very light
L/S = light tuberculation in scribe
M/S = medium tuberculation in scribe
H/S = heavy tuberculation in scribe
O/L = light rusting in scribe
O/M =

Panels on Weathered System I

ation	Scribe Rusting	Blistering	Undercutting	Scribe Blistered	Comments
TM D661; Flaking: ASTM D772; Rusting: ASTM D610; Blistering: ASTM D714.]					
tem 1					
0	O/M; O/M	8/MD; 8/L	10; 10	6/MD; 6/MD	Most of damage on old scribe.
0	O/M; O/M	8/MD; 8/M	10; 10	6/D; 4/MD	
2	O/M; O/M	8/MD; 8/M	10; 10	2/D; 2/MD	
	O/M; O/M	6/D; 8/M	9; 9	2/D; 2/MD	
	O/M; O/MD	6/D; 8/M	9; 9	2/D; 2/MD	
	O/D; O/D	4/D; 6/MD	9; 9	2/D; 2/MD	
em 3					
0	O/M; D	10; 10	10; 10	4/D; 4/D	Damage mostly on edge and old scribe.
	O/M; D	10; 10	9; 9	4/D; 4/D	
	O/M; D	10; 10	9; 9	2/D; 2/D	
	O/D; D	8/L; 8/L	9; 9	2/D; 2/D	
	O/D; D	6/L; 4/L	9; 9	2/D; 2/D	
	O/D; D	2/L; 2/L	9; 9	2/D; 2/D	
em 4					
0	O/L; O/L	10; 10	10; 10	8/L; 8/M	Damage mostly on edge and old scribe.
0	O/L; O/L	10; 8/M	10; 10	8/L; 8/M	
0	O/M; O/M	10; 8/M	10; 10	2/L; 6/M	
	O/M; O/M	8/M; 6/M	10; 9	2/L; 6/M	
	O/M; O/M	8/M; 6/M	9; 9	2/L; 2/M	
	O/M; O/M	2/M; 4/M	9; 9	2/L; 2/M	
em 5					
0	O/M; O/M	10; 10	10; 10	2/M; 2/M	Damage mostly on edge and old scribe.
	O/D; O/M	8/MD; 10	9; 10	2/D; 2/M	
	O/D; O/M	8/MD; 10	9; 10	2/D; 2/M	
	O/D; O/D	8/MD; 8/M	9; 9	2/D; 2/M	
	O/D; O/D	8/MD; 8/MD	9; 9	2/D; 2/MD	
	O/D; O/D	8/MD; 8/D	9; 9	2/D; 2/D	
em 6					
0	O/M; O/M	10; 8/D	10; 10	6/D; 8/D	Damage mostly on edge or old scribe.
	O/M; O/M	10; 8/D	10; 10	6/D; 6/D	
	O/M; O/D	10; 8/D	10; 9	6/D; 2/D	
	O/D; O/D	10; 8/D	9; 9	4/D; 2/D	
	O/D; O/D	10; 6/D	9; 9	2/D; 2/D	
	O/D; O/D	10; 6/D	9; 9	2/D; 2/D	

medium tuberculation in scribe   O/M = medium rusting in scribe
heavy tuberculation in scribe
light rusting in scribe

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Table C-3. Ratings of System Panels on Weatherc

[Ratings according to following standards — Chalking: ASTM D659; Cracking: ASTM D661; Flaking: A

Time Exposed (yr)	General Protection	Discoloration	Chalking	Cracking	Flaking	Rusting		Tuberculation	Scribe Rusting
						Type I	Type II		
System 1									
1/2	8^+; 8^+	8; 8	4; 4	10; 10	10; 10	9; 9	9; 9	10; 10	O/L; O/L
1	8; 8	7; 7	4; 4	10; 10	10; 10	9; 9	9; 9	10; 10	O/L; O/L
1-1/2	8; 8	7; 7	4; 4	10; 10	10; 10	9; 9	9; 9	10; 10	O/M; O/L
2	8; 8	7; 7	2; 2	10; 10	10; 10	9; 9	9; 9	10; 10	O/M; O/L
2-1/2	8; 8	7; 6	2; 2	10; 10	10; 10	9; 9	9; 9	9; 9	O/M; O/L
3	8^-; 8^-	7; 6	4; 4	10; 10	10; 10	9; 9	9; 9	9; 9	O/M; O/M
System 3									
1/2	9; 9	10; 10	8; 6	10; 10	10; 10	9; 9	10; 10	10; 10	O/M; O/M
1	8^+; 8^+	9; 8	8; 6	10; 10	10; 10	9; 9	9; 9	10; 10	O/M; O/M
1-1/2	8^+; 8^+	9; 7	6; 4	10; 10	10; 10	9; 9	9; 9	10; 10	O/M; O/M
2	8^+; 8	8; 6	6; 6	10; 10	10; 10	9; 9	9; 9	9; 9	O/D; O/M
2-1/2	8; 8	7; 6	4; 6	10; 10	10; 10	9; 9	9; 9	9; 9	O/D; O/M
3	8^-; 7	6; 5	4; 4	10; 10	10; 10	9; 9	9; 9	9; 9	O/D; O/D
System 4									
1/2	9^+; 9^+	10; 10	8; 8	10; 10	10; 10	10; 10	10; 10	10; 10	O/L; O/L
1	9; 9	9^+; 9^+	8; 8	10; 10	10; 10	10; 10	10; 10	10; 10	O/L; O/L
1-1/2	9; 9	9^+; 9^+	4; 6	10; 10	10; 10	10; 10	10; 10	10; 10	O/L; O/L
2	9^-; 9^-	9; 9	8; 8	10; 10	10; 10	10; 10	9; 9	9; 9	O/L; O/L
2-1/2	8^+; 8	9; 8	8; 8	10; 10	10; 10	9; 9	9; 9	9; 9	O/L; O/M
3	8^+; 8^-	8; 7	6; 6	10; 10	10; 10	9; 9	9; 9	9; 9	O/M; M
System 5									
1/2	9^+; 8^+	9; 8	8; 8	10; 10	10; 10	9; 10	10; 10	10; 10	O/L; O/L
1	9; 8^+	9; 8	8; 8	10; 10	10; 10	9; 10	10; 10	10; 10	O/L; O/L
1-1/2	9; 8	9; 8	8; 6	10; 10	10; 10	9; 10	10; 10	10; 10	O/M; O/L
2	9; 8	9; 8	8; 8	10; 10	10; 10	9; 10	9; 9	9; 9	O/M; O/L
2-1/2	8; 8	9; 8	8; 8	10; 10	10; 10	9; 9	9; 9	9; 9	O/D; O/L
3	8; 8	8; 8	8; 6	10; 10	10; 10	9; 9	9; 9	9; 9	O/D; O/M
System 6									
1/2	9; 9	9; 9	6; 6	10; 10	10; 10	9; 9	9; 9	10; 10	O/L; O/L
1	9^-; 9^-	9; 9	6; 6	10; 10	10; 10	9; 9	9; 9	10; 10	O/M; O/M
1-1/2	9^-; 8^+	9; 9	4; 4	10; 10	10; 10	9; 9	9; 9	10; 10	O/M; O/M
2	8; 8^+	9; 9	6; 6	10; 10	10; 10	9; 9	9; 9	9; 9	O/M; O/M
2-1/2	8; 8	8; 8	4; 4	10; 10	10; 10	8; 8	8; 8	9; 9	O/M; O/D
3	8^-; 8	7; 7	6; 6	10; 10	10; 10	8; 8	8; 8	9; 9	O/M; O/D

NOTE: Meaning of abbreviations –

E = edge
F = few
S = slight

M = medium
H = heavy
D = dense

L = light
V/L = very light
L/S = light tuberculation in scribe

M/S = medium tuberculatic
H/S = heavy tuberculation
O/L = light rusting in scribe

Table C-3. Ratings of System Panels on Weathered System II

ing standards — Chalking: ASTM D659; Cracking: ASTM D661; Flaking: ASTM D772; Rusting: ASTM D610; Blistering: ASTM D714.]

acking	Flaking	Rusting		Tuberculation	Scribe Rusting	Blistering	Undercutting	Scribe Blistered	Comments
		Type I	Type II						
				System 1					
0; 10	10; 10	9; 9	9; 9	10; 10	O/L; O/L	8/MD; 8/MD	10; 10	6/M; 6/MD	Damage mostly on edge and old scribe.
0; 10	10; 10	9; 9	9; 9	10; 10	O/L; O/L	6/MD; 8/D	10; 10	6/M; 6/MD	
0; 10	10; 10	9; 9	9; 9	10; 10	O/M; O/L	2/MD; 6/D	10; 10	4/M; 6/MD	
0; 10	10; 10	9; 9	9; 9	10; 10	O/M; O/L	2/MD; 6/D	9; 9	4/M; 2/MD	
0; 10	10; 10	9; 9	9; 9	9; 9	O/M; O/L	2/MD; 4/D	9; 9	4/MD; 4/MD	
0; 10	10; 10	9; 9	9; 9	9; 9	O/M; O/M	2/D; 4/D	9; 9	4/MD; 4/MD	
				System 3					
0; 10	10; 10	9; 9	10; 10	10; 10	O/M; O/M	10; 10	10; 10	2/D; 2/L	Damage mostly on edge and old scribe.
0; 10	10; 10	9; 9	9; 9	10; 10	O/M; O/M	8/L; 8/M	10; 9	2/D; 2/L	
0; 10	10; 10	9; 9	9; 9	10; 10	O/M; O/M	6/L; 8/M	9; 9	2/D; 2/L	
0; 10	10; 10	9; 9	9; 9	9; 9	O/D; O/M	6/MD; 8/M	9; 9	2/D; 2/L	
0; 10	10; 10	9; 9	9; 9	9; 9	O/D; O/M	6/MD; 8/M	9; 9	2/D; 2/L	
0; 10	10; 10	9; 9	9; 9	9; 9	O/D; O/D	4/MD; 8/MD	9; 9	2/D; 2/MD	
				System 4					
0; 10	10; 10	10; 10	10; 10	10; 10	O/L; O/L	10; 10	10; 10	6/MD; 4/M	Damage mostly on edge and old scribe.
0; 10	10; 10	10; 10	10; 10	10; 10	O/L; O/L	10; 10	10; 10	6/MD; 4/M	
0; 10	10; 10	10; 10	10; 10	10; 10	O/L; O/L	10; 10	10; 10	2/MD; 2/M	
0; 10	10; 10	10; 10	9; 9	9; 9	O/L; O/L	8/M; 8/MD	9; 9	2/MD; 2/M	
0; 10	10; 10	9; 9	9; 9	9; 9	O/L; O/M	6/M; 6/MD	9; 9	2/MD; 2/M	
0; 10	10; 10	9; 9	9; 9	9; 9	O/M; M	4/MD; 4/MD	9; 9	2/MD; 2/M	
				System 5					
0; 10	10; 10	9; 10	10; 10	10; 10	O/L; O/L	10; 6/M	10; 10	4/L; 4/L	Damage mostly on edge or old scribe.
0; 10	10; 10	9; 10	10; 10	10; 10	O/L; O/L	10; 4/M	10; 10	4/L; 2/L	
0; 10	10; 10	9; 10	10; 10	10; 10	O/M; O/L	10; 4/M	10; 10	2/L; 2/L	
0; 10	10; 10	9; 10	9; 9	9; 9	O/M; O/L	8/M; 2/MD	9; 9	2/M; 2/L	
0; 10	10; 10	9; 9	9; 9	9; 9	O/D; O/L	8/MD; 2/D	9; 9	2/MD; 2/L	
0; 10	10; 10	9; 9	9; 9	9; 9	O/D; O/M	8/D; 2/D	9; 9	2/MD; 2/L	
				System 6					
0; 10	10; 10	9; 9	9; 9	10; 10	O/L; O/L	8/M; 8/L	10; 10	4/D; 4/D	Damage mostly on edge and old scribe.
0; 10	10; 10	9; 9	9; 9	10; 10	O/M; O/M	6/MD; 6/L	10; 10	4/D; 4/D	
0; 10	10; 10	9; 9	9; 9	10; 10	O/M; O/M	4/MD; 4/L	10; 10	2/D; 2/D	
0; 10	10; 10	9; 9	9; 9	9; 9	O/M; O/M	4/MD; 4/L	9; 10	2/D; 2/D	
0; 10	10; 10	8; 8	8; 8	9; 9	O/M; O/D	4/MD; 4/L	9; 9	2/D; 2/D	
0; 10	10; 10	8; 8	8; 8	9; 9	O/M; O/D	4/D; 4/L	9; 9	2/D; 2/D	

L = light
/L = very light
/S = light tuberculation in scribe
M/S = medium tuberculation in scribe
H/S = heavy tuberculation in scribe
O/L = light rusting in scribe
O/M = medium rusting in scribe

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Table C-4. Ratings of System Panels on Weathered System II

[Ratings according to following standards — Chalking: ASTM D659; Cracking: ASTM D661; Flaking: ASTM D772;

Time Exposed (yr)	General Protection	Discoloration	Chalking	Cracking	Flaking	Rusting		Tuberculation	Scribe Rusting	Blist
						Type I	Type II			
System 1										
1/2	9^-	9	4	10	10	9	9	10	O/L	1
1	8^+	9	4	10	10	9	9	10	O/M	1
1-1/2	8^+	9	4	10	10	9	9	9	O/M	1
2	8^+	9	4	10	10	9	9	9	O/MD	2/
2-1/2	8^+	8	2	10	10	9	9	9	O/MD	2/
3	8	7	2	10	10	9	9	9	O/MD	2/
System 3										
1/2	9	9	6	10	10	9	9	10	O/M	1
1	8^+	9	6	10	10	9	9	10	O/M	1
1-1/2	8^+	9	4	10	10	9	9	10	O/M	1
2	8	7	4	10	10	9	9	9	O/D	1
2-1/2	8^-	6	4	10	9	8	8	9	O/D	6/
3	6	4	2	10	8	8	8	9	O/D	2/
System 4										
1/2	10	10	8	10	10	10	10	10	O/L	1
1	9^+	9	8	10	10	10	10	10	O/L	1
1-1/2	9^+	9	8	10	10	10	10	10	O/L	1
2	9^-	9	8	10	10	9	9	10	O/M	8/
2-1/2	8^+	9	8	10	10	9	9	9	O/M	4/
3	8	8	8	10	10	9	9	9	O/MD	2/
System 5										
1/2	9^+	10	6	10	10	9	10	10	O/L	1
1	9^-	9	6	10	10	9	9	10	O/M	1
1-1/2	9^-	9	6	10	10	9	9	10	O/M	1
2	8^+	8	6	10	10	9	9	9	O/MD	8/
2-1/2	8	8	8	10	10	8	8	9	O/MD	8/
3	8^-	8	8	10	10	8	8	9	O/D	8/M

NOTE: Meaning of abbreviations –

E = edge
F = few
S = slight
M = medium
H = heavy
D = dense
L = light
V/L = very light
L/S = light tuberculation in scribe
M/S = medium tuberculation in scribe
H/S = heavy tuberculation in scribe
O/L = light rusting in scribe
O/M = medium rusting in scribe

[a] Rating discontinued after failure.

Table C-4. Ratings of System Panels on Weathered System III

Chalking: ASTM D659; Cracking: ASTM D661; Flaking: ASTM D772; Rusting: ASTM D610; Blistering: ASTM D714.]

Rusting		Tuberculation	Scribe Rusting	Blistering	Undercutting	Scribe Blistered	Comments
Type I	Type II						
		System 1					
9	9	10	O/L	10	10	6/L	Damage mostly at edge and old scribe.
9	9	10	O/M	10	10	6/L	
9	9	9	O/M	10	10	4/L	
9	9	9	O/MD	2/F	10	4/L	
9	9	9	O/MD	2/F	9	2/M	
9	9	9	O/MD	2/F	9	2/M	
		System 3					
9	9	10	O/M	10	9	4/MD	Damage mostly at edge and old scribe.
9	9	10	O/M	10	9	4/MD	
9	9	10	O/M	10	9	2/D	
9	9	9	O/D	10	9	2/D	
8	8	9	O/D	6/M	9	2/D	
8	8	9	O/D	2/D	9	2/D	Failed.[a]
		System 4					
10	10	10	O/L	10	10	10	Damage mostly on edge or old scribe.
10	10	10	O/L	10	10	8/M	
10	10	10	O/L	10	10	8/M	
9	9	10	O/M	8/M	10	8/M	
9	9	9	O/M	4/M	9	4/M	
9	9	9	O/MD	2/D	9	4/M	
		System 5					
9	10	10	O/L	10	10	8/L	Damage mostly on edge or old scribe.
9	9	10	O/M	10	10	4/L	
9	9	10	O/M	10	9	2/L	
9	9	9	O/MD	8/L	9	2/MD	
8	8	9	O/MD	8/M	9	2/MD	
8	8	9	O/D	8/MD	9	2/MD	

[a] Rating discontinued after failure.

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